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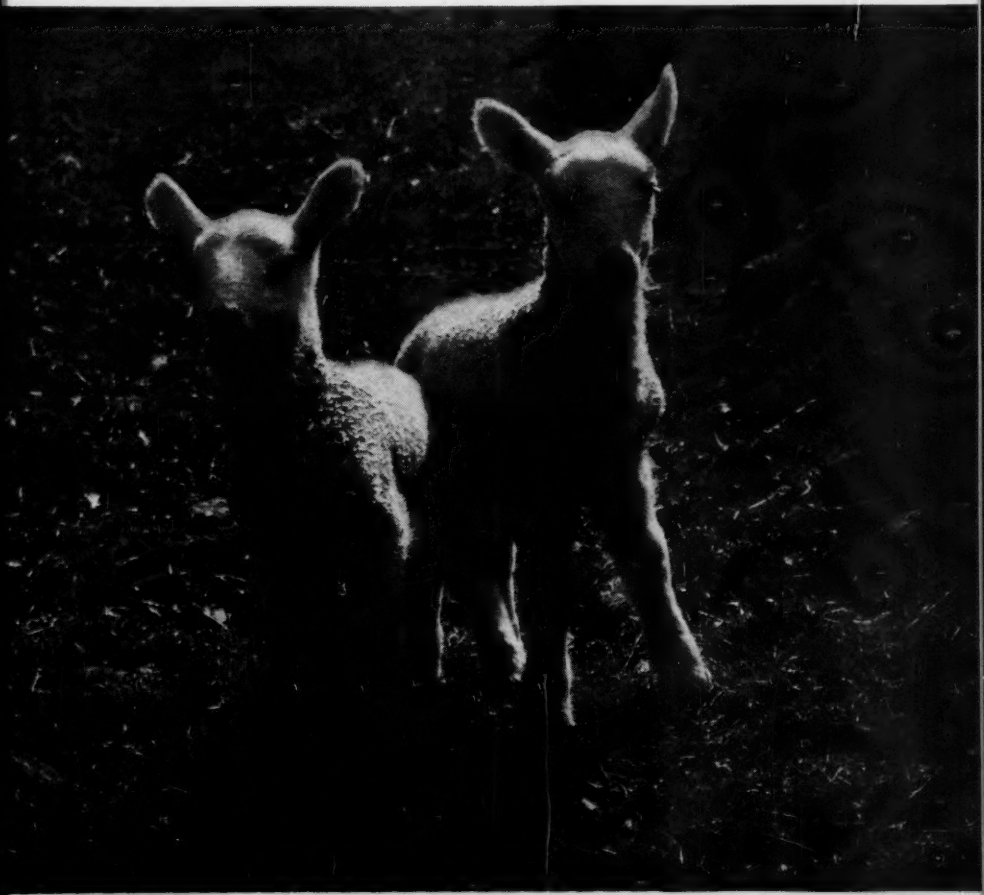
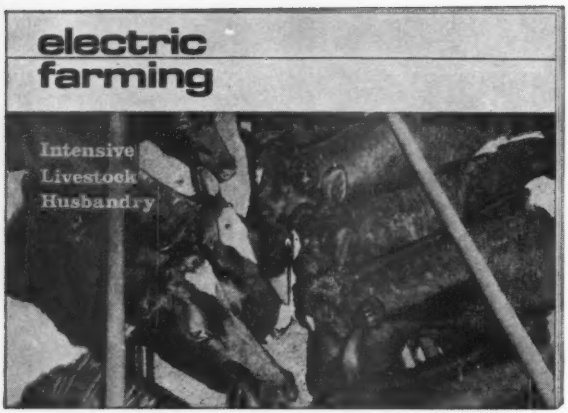


Lambs in Westmorland

Increasing Farmers' Income
without Heavy Capital Investment pages 55–59



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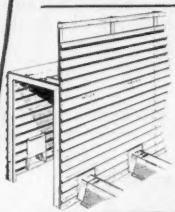

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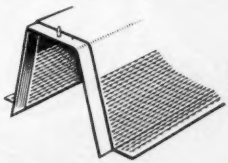

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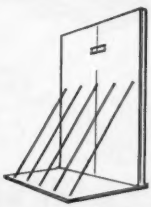

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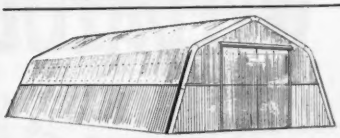

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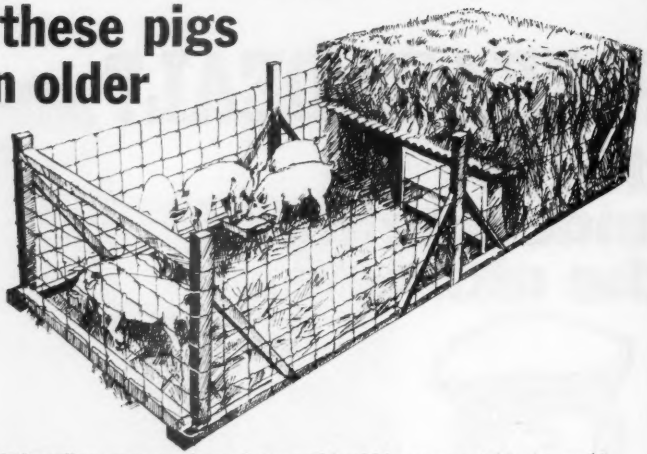

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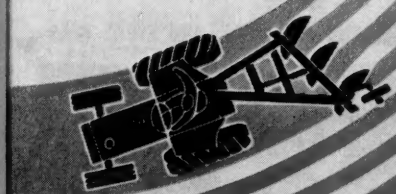

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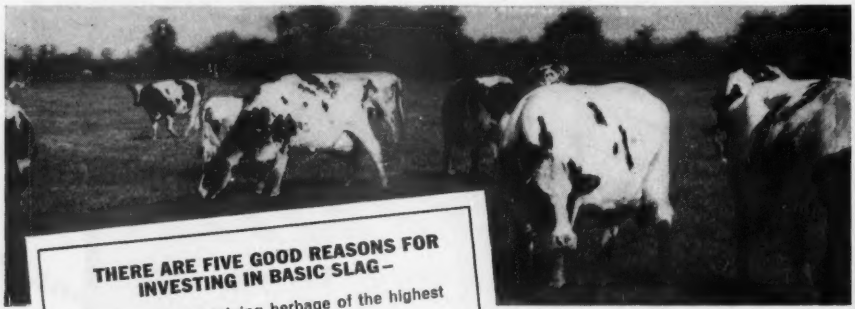

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Agriculture

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Increasing Farmers' Income

Without Heavy Capital Investment

Brian Davey

ONE of the outstanding features of British agriculture during the last decade has been that it has become a much more capital-intensive industry. Farmers have been investing increasing sums of money each year in fixed capital assets of all kinds, as the following table demonstrates:

Gross fixed capital formation in agriculture by type of asset

	1956	1960	1965
	£*m.*	£*m.*	£*m.*
Vehicles	17	24	22
Plant and machinery	50	76	86
Building and works	27	45	68
Total	94	145	176

Examples of the type of capital investments which farmers have been making include the rapid expansion of mechanization, particularly of crop production, the investment in grain drying and storage plants on cereal growing farms, and the trend towards loose-housing and parlour-milking systems on dairy farms. Many of these improvements have involved individual farmers in the investment of large sums of capital, for instance, a new grain drying and storage plant to handle 500 tons of grain annually could cost from £5,000 to £9,000 depending on individual circumstances.

Alternatives to investment

The capital needed for these investments has been obtained from a variety of sources. In some cases it has come out of savings or income, but more

usually the farmer has borrowed at least part of his capital requirements from one of the agricultural credit institutions which offer medium or long-term credit facilities such as the banks, the Agricultural Mortgage Corporation or the Lands Improvement Company. In addition, grants under the Farm Improvement Scheme can reduce capital requirements appreciably. There is no doubt that this capital investment, coupled with the reorganization of farming systems which often accompanies the investment of large sums of capital on farms, has contributed substantially to the improvement in farm incomes during the last decade.

In times like the present, however, when there is a severe and general restriction on the supply of credit, farmers may have to look for other ways of maintaining or improving their incomes. Whilst they should still be able to obtain the short-term credit which is often needed to meet seasonal commitments, they may, like all industrialists and businessmen, suffer from the shortage of long-term credit and fixed investment on farms may suffer a check. Moreover, credit is not only scarce, it also has a high annual cost with interest rates of 8 or 8½ per cent. Nevertheless, despite this restriction, there are several means by which farmers can continue to achieve higher incomes. For instance, part of the increase in farm income in recent years can be attributed to the application by farmers of technological improvements which involve them in little or no additional expenditure. These include the use of improved varieties of crops giving higher yields, the introduction of hybrid poultry, the increased use of chemical methods of pest and weed control, and the adoption of the latest veterinary products to control animal diseases. In brief, the answer to the question of how to increase incomes without investing too much capital, lies in tightening up the organization and management of the farm business to ensure that it is being run at or near peak efficiency. This means improving or eliminating the least profitable enterprises and expanding the most profitable ones, ensuring that the farm is being operated efficiently, and taking advantage of the latest innovations and techniques produced by the agricultural scientists. This can often be done without the need to invest large sums of capital in the business.

Specialization

The first step in this, or indeed any other, improvement process is to examine the farm business to see which of the enterprises are operating satisfactorily and which are not. One way to do this is to prepare gross margins for each enterprise. The gross margin is, of course, the difference between the output obtained from the enterprise and the variable costs incurred specifically in its production. For crops, the main items of variable costs are seeds, fertilizers, sprays, casual labour and contract hire. For livestock, they are feedingstuffs and veterinary expenses.

An examination of the gross margins of the various enterprises making up the farm business—dairy cows, sheep, pigs, cereals, potatoes, and so on—will show which are making a significant contribution to meeting the fixed costs of the business and which are not. It may reveal, for instance, that a small sideline enterprise, such as pigs and poultry, is making very little contribution to farm income. Under these circumstances, and especially if the performance of the enterprise cannot be improved quickly and easily, the farmer may decide to dispense with small subsidiary enterprises and specialize in his major lines of production. A factor to bear in mind in this

particular context is that the abandonment of a whole enterprise should release capital which could be invested in other parts of the farm business; for example, it might be used to expand production from the more profitable enterprises on the farm.

THE AUTHOR

Brian Davey, B.Sc.(Agric.), is a Lecturer in Agricultural Economics at the University of Newcastle upon Tyne. He was previously an Agricultural Economist in the Economics Division of the Ministry

Improving the efficiency of enterprises

The analysis may also reveal some deficiencies in apparently profitable enterprises, particularly if the gross margins can be compared on a per unit basis (£ per head or per acre) with suitable standards such as those published from time to time by the University Departments of Agricultural Economics. For example, in livestock enterprises, particularly dairying, pigs and poultry, gross margins are often low due to the inefficient feeding of concentrates. This is sometimes because there is no satisfactory system of rationing according to yield. In other cases it is the result of wasteful practices such as the use of inaccurate feed dispensers, or the habit of encouraging cows into the cowshed or parlour with a handful of concentrates, even in the spring and summer when grazing might be expected to provide the cows' feed requirements in full. The relationship between output and feed input is critical to profitable livestock production; it is often possible to make economies in feed use without significantly affecting the level of output. These savings can be quite substantial in money terms. For example, 1 lb of concentrates saved per day is equivalent to an annual saving of about £250 in feed costs for a herd of 40 dairy cows. It is well worth while, therefore, joining either the Milk Marketing Board Low Cost Production Scheme or the N.A.A.S. Dairy (and Poultry) Management Scheme to keep a strict control over this important factor. Further savings in feed costs may be made, particularly with cattle, through the home-mixing of concentrate feeds.

A poor stocking rate is another common cause of low margins in grazing livestock enterprises. Improving the management of the grass and forage acreage, particularly through higher fertilizer applications, can provide farmers with the opportunity to improve their incomes. If the area of grass, etc., needed to maintain the existing dairy or beef herd and the sheep flock

can be reduced, the farmer has the choice of expanding his grazing livestock enterprises or utilizing the land which has been released for some other purpose, e.g., cash crop production.

So far as improving the margin from cropping enterprises is concerned, the achievement of higher yields through increased fertilizer applications is an avenue which could be exploited profitably. For whilst fertilizer consumption has been expanding during the last decade, many farmers are still reluctant to apply the quantity of fertilizer needed to obtain the full potential from their crops. For example, it is worth remembering that if more adequate fertilizer use, coupled with the latest varieties and pest and disease control techniques, enabled cereal yields to increase by 5 cwt per acre, the gross return on 50 acres of cereals would be increased by over £300.

Fixed costs

It would be wrong in an analysis of this kind to ignore completely the fixed costs of the business, for it is sometimes possible to effect savings in certain items. Rent and also machinery costs (for historical reasons) are usually fixed in the true sense of the word, but it may be possible to make economies in labour use. However, for the savings to mean anything in financial terms, either a whole man must be released from the business or another use found for the labour that can be saved. Economizing in labour use on the cereals enterprise, for instance, may not add a penny to farm profits if the man is still required to help tend the farm livestock. More output must be obtained either from the cereals or from the livestock to utilize the spare labour made available if any benefit is to be gained in these circumstances.

Capital for expansion

The results of the analysis may suggest that the best course of action is to expand the more profitable enterprises on the farm. This would normally call for the investment of capital by the farmer, but it need not necessarily mean that he must invest large additional sums of capital in his business. Capital outlay can be kept to a minimum by taking advantage of the cheap developments in buildings, etc., which have themselves been developed by farmers forced to expand their businesses with the minimum of capital investment.

One or two examples will illustrate this point. In dairying, farmers who wish to expand their dairy herds will probably find that additional winter housing is required. They may like to consider converting their existing cowsheds and other buildings to cow cubicles instead of constructing a new yard. If the existing buildings are inadequate and new buildings are essential, the capital outlay may be kept down by erecting cheap cow kennels, using, for instance, timber and corrugated sheeting, rather than a more sophisticated building; a limitation of cow kennels, however, is that they are not suitable for the northerly or more exposed parts of the country.

On cropping farms where expansion of the cereals acreage may call for more grain drying and storage facilities, floor drying and storage in existing buildings would represent a substantial saving on more specialized drying and storage equipment, e.g., bins. One must be sure, however, that the walls of old buildings are strong enough for this purpose. Where floor drying and

storage is practicable, very little conveying equipment is needed apart from a simple auger. Where there is a ready sale, or if the grain is to be fed to farm livestock, damp grain storage in butyl bags, costing about £4 10*s*. per ton, is another cheap method of storing grain which can be considered.

Technological innovations

As well as examining their businesses critically to identify and correct weaknesses in management and organization, farmers can also maintain and improve their incomes by keeping abreast of the latest technological innovations developed by the agricultural scientists. Farmers have often been criticized for their conservative attitude and behaviour, but they have been extremely quick to adopt new procedures and techniques to meet the challenge arising from level or falling product prices and higher costs.

Many of these developments lead to improvements in yields. For example, the new and better varieties of cereals bred by the plant geneticists, coupled with the development of chemical methods of controlling pests and diseases, have led to substantial improvements in average yields per acre—wheat yields, for instance, averaged 33 cwt per acre in 1964 compared with only 22·7 cwt per acre ten years earlier. Similarly, the introduction of hybrid poultry has given farmers the opportunity to obtain higher yields of eggs for a lower input of feed. Other developments, and particularly the introduction of bigger and better machines, have provided the chance to economize on labour use. Economies on feed and labour have also resulted from the spread of better-designed, better-insulated buildings. The adoption of these latter developments may involve farmers in heavy capital expenditure, but developments such as the continued introduction of higher-yielding crop varieties, more concentrated fertilizers, and more effective week-killers, pesticides and medicines, involve little or no capital investment by the farmer who adopts them. They do, however, provide him with an immediate income bonus through the higher yields which follow from their application.

Conclusion

Thus, if farmers cannot obtain extra capital to increase their farm income, they will be forced to look for other ways of achieving higher incomes. There are several ways in which they can do this. Farmers can streamline and improve the efficiency of their business operations by eliminating the unprofitable enterprises and specializing on the profitable ones. They can expand the more profitable enterprises and ensure that they are operating as efficiently as possible by achieving good yields and economizing on costs wherever possible. In short, they can take the slack out of their existing systems. They can also take advantage of the latest yield-increasing technical developments at no extra cost. All this can be done without the need to invest large sums of capital in the business, and the effects on farm income can be more than sufficient to offset any pressure arising from higher factor costs.

Wild Oats

E. R. Bullen

Director, Boxworth
Experimental Husbandry Farm

WHEN the land which is now the Boxworth Husbandry Farm was taken over by the War Agricultural Committee in July, 1940, the valuers' report made it very clear that a wild oat problem was taken over as well. Intensive cereal cropping in the war years ensured that this weed was still troublesome when the land became a husbandry farm after Michaelmas, 1948 . . . 'One of the first tasks on entering the farm was to reduce the very heavy infestation of wild oats . . .' (E. T. Sykes, *Agriculture*, December, 1956, pp. 421–4).

Due to the requirements of experimental work, the farming system changed in the early 1950s. The need to work on livestock meant that leys were brought in to the corn-dominated arable system and arable silage crops were grown for stock-feeding; the potato crop was increased to about 50 acres each year. By using these methods, and especially by the use of cleaning crops in two successive years, the wild oat had less opportunity to get out of hand and by the late-1950s the farm had become relatively clean.

Field trials

Experimental work on the control of wild oats (*Avena fatua*) at Boxworth concentrated on two aspects, both based on fundamental studies of the biology of the weed carried out by Miss J. M. Thurston at Rothamsted. There was little evidence of the survival of wild oat seeds in leys under field conditions, and accordingly a trial to study this was commenced. The field chosen had been severely infested with wild oats before being sown to ley under wheat in 1950. Plots were ploughed up each year from 1954 (when the ley had been down for three years) and each year seedbeds were prepared in which wild oat seedlings could germinate. Counts made (see table 1) showed that after even a four-or-five-year ley, there was sufficient seed survival to cause a troublesome infestation in the first crop. It took at least eight years under grass for the wild oats to become negligible

(Forbes, 1963).[1] These plots were, of course, managed so that no return of wild oats was permitted in dung, or animal fodder. General confirmation of this finding has come when long leys have been ploughed up at Boxworth, the wild oat problem always being much less serious than before the ley was established.

However, leys as long as six years are hardly an attractive proposition for the arable farmer in eastern England. His land is seldom fenced or watered, and by tradition he is not a stockman. Further, rising land prices have forced the pace towards a level of intensification which ensures that leys, if they exist at all, have to be shorter than six years.

TABLE 1

	Number of wild oat seedlings	
	Per acre	Per sq. yd
1954 after 3 years in ley	38,000	7·9
1955 after 4 years in ley	11,000	2·3
1956 after 5 years in ley	8,000	1·7
1957 after 6 years in ley	270	0·05
1958 after 7 years in ley	136	0·028
1959 after 8 years in ley	10	0·0002
1960 after 9 years in ley	0	0
1961 after 10 years in ley	3	0·00006

Continuous spring barley

The other experiment is concerned with wild oats in continuous spring barley and this was planned in the mid-1950s, before there was any prospect of successful chemical control of wild oats in cereals, to exploit the biological weaknesses of the wild oat. Cultural methods of controlling wild oats in the growing cereal, such as steerage hoeing, were showing little promise. The attack had to be directed either to the stubble, after harvest, or to the seedbed early in the spring. Stubble cultivation by shallow ploughing and rotary cultivating were compared with no cultivation each autumn, combined with either burning the straw or removing it by baling. Each spring normal drilling was compared with delayed drilling where the wild oats were permitted to germinate before the barley was sown (Whybrew).[2]

Over the eight years up to 1964, wild oats built up steadily in continuous barley where this was sown at the normal time. In 1957, the field contained about two wild oat plants per square yard. On average, there was a seventy-fold increase by 1964, but the 'wild oat explosion' was definitely muffled by *not* stubble cultivating, and it was further checked by burning the straw (see table 2). Although many more seeds germinate in the late autumn on the cultivated plots, and these seedlings are eliminated when the land is ploughed, the effort in fact benefited the wild oat and the fuel supplier rather than the farmer. Observations on the undisturbed stubbles, where cages have been used to exclude birds and rodents, have shown that considerably more seeds survive under the cage than on the stubble. Presumably the effect of stubble cultivation, although beneficial to some extent in encouraging germination, is on balance harmful by burying many dormant seeds where they cannot be consumed.

[1]Forbes, N. (1963). The Survival of Wild Oat Seeds under Long Ley. *Experimental Husbandry* 9, pp. 10–13.

[2]Whybrew, J. E. (1964). Proc. Seventh British Weed Control Conference, pp. 614–620.

By 1963, wild oats in plots sown early since 1957 (left), were so numerous that 5 cwt per acre more barley was grown by the cleaner crop sown some weeks later (right)

TABLE 2

Wild oat plants per sq. yd in early-drilled barley

Straw disposal	Stubble cultivation	At harvest 1962	At harvest 1963	At harvest 1964
Burnt	None	7·2	9·5	59·2
	Plough	25·6	36·2	146·7
	Rotary cultivator	31·2	42·4	188·7
Baled	None	13·0	17·8	102·0
	Plough	37·6	57·9	152·7
	Rotary cultivator	66·1	74·0	225·7

In contrast to the limited benefit from straw burning and the rather unexpected failure of autumn stubble treatments, delayed drilling reduced wild oats to about 65 plants per acre, although they have tended to increase slightly from this very low level. Nevertheless, late drilling proved to be a reliable means of keeping wild oats at a low level. Traditionally 'cuckoo barley' is reputed to be a certain failure, but this has not been our experience, particularly with modern varieties, provided that a mildew-resisting variety is chosen, and the cultivations to kill the wild oat seedlings in late April are planned to avoid excessive moisture loss. Of course, the crop at Boxworth is sown on a moisture-retaining soil, even though the area has only a 21 inch annual average rainfall. In the past two years, Impala barley has averaged 41 cwt per acre sown on 10th March, but still achieved (plot) yields of 39 cwt per acre after drilling about 27th April. Kloka wheat has given virtually identical yields (37 and 37½ cwt respectively) at the same dates. These differences were recorded on land relatively free from wild oats; where wild oats are numerous they can easily account for much larger

losses than delayed drilling. In 1963 and 1964 clean late-drilled barley outyielded wild oat infested early-drilled plots by 5 and 10 cwt per acre respectively.

A new phase

In 1964, after eight years of early-drilled barley, we had reached a wild oat incidence averaging 146 plants per square yard, smothering fairly effectively the barley crop, which yielded only a ton per acre. In 1965 and 1966 we started a new phase—to clean up these plots, using either the Boxworth delayed drilling technique, or a pre-emergence herbicide ('triallate'). Both methods succeeded, as the yields were raised to between 32 and 42 cwt per acre; the wild oats counts came down to between 1·2 and 7 per square yard, probably below the level where they can influence yield. On average, the herbicide-treated early-sown plots outyielded the late-drilled plots by 7 cwt, with a similar wild oat incidence. Clearly this paid for the chemical, but it is too soon to conclude that the late drilling is outmoded.

In the past two years our farming system has changed again. Our ley acreage is contracting and we are once more increasing our cereal acreage. At present we have about 600 acres of tillage crops. About a third of this is substantially free from wild oats; the problem here is to keep it so. Clean seed, of course, is essential; it is also necessary to avoid the transport of seeds in combines or in dung from the 'dirty' part of the farm. This is more easily said than done. A further third has an appreciable wild oat population. So far, it is probably fair to claim that the numbers are unlikely to be affecting yields significantly, but most of this land is unsuitable for leys and we have to ensure that the situation does not get out of hand. The occasional one-year break cannot achieve miracles where weeds have dormant seeds, especially as wild oats are difficult to control chemically in the 'combineable' breaks we can most conveniently grow. The best insurance for us is, I am convinced, to use successive crops of spring wheat or barley as the crops to check wild oats. This means costly chemicals or delayed drilling; but this is justified where there is a real or even potential problem.

A more difficult situation arises on the remaining third of the arable. Here we believe the problem is a fairly small one, but the enemy is unpredictable and one may have an unexpected infestation almost any year on fields where there have been few obvious wild oats for several years. One cannot here contemplate the expense of routine precautionary measures, but must rely on first aid by selective use of barban if one has been prudent in choosing the barley varieties to grow.

Minimize the damage

Boxworth, alone of the husbandry farms, has a wild oat problem. So have the farmers occupying about a million acres of arable land who are estimated to lose about 2½ million cwt of grain each year. Farming heavy arable land, with cereal-dominated rotations, means that we can hardly eradicate wild oats once they are established. I believe we will have to live with this problem, but always ensure that the weed is kept below the level where crop yields suffer.

Land Ownership and Share Tenancy Systems

K. B. C. Jones

SINCE 1925 the English legal system has only recognized two estates in land—freehold and leasehold. The freeholder holds his title in perpetuity, and has a common law freedom to use and enjoy his property as he pleases, whilst the leaseholder buys the enjoyment of an estate for a given number of years in return for an annual rent. The lease may impose restrictions on the tenant, but these would have been agreed before the document was signed. The two estates in land apply equally to residential, commercial and agricultural properties, but this article is only concerned with farms.

The deficiencies of the present system

The owner-occupier of agricultural land enjoys many benefits, but suffers the disadvantage that large amounts of capital are tied up in the freehold, and these resources are not available for trading purposes unless the property is mortgaged or used as security for a bank loan. Also, the freeholder, if forced to sell, probably cannot realize his asset as quickly as a tenant because of the necessity of selling land on a steady or rising market and not on a falling one. Substantial movements in land prices in the short term can be brought about by changes in planning or tax law, or credit restrictions in times of economic difficulty. Freehold land is a long-term rather than a short-term investment.

The traditional system of leasehold tenure provides the owner with a known return on his capital invested, and the tenant with a freedom to operate the farming system of his choice within the limits of his tenancy agreement. The arrangement allows the owner to be free of day-to-day responsibilities, and the tenant enjoys the whole of the profit from the land except that part which is paid in rent. The system is probably adequate for the tenant who has ample working capital, but is not very satisfactory for the young man who has technical ability and enthusiasm, but insufficient money of his own to buy or rent a holding and then equip it to viable standards.

An annual tenancy also holds disadvantages for the landlord, because although the tenant can give notice to quit at any time, the landlord is normally barred from re-possessing his property by the Agricultural Holdings Act 1948. To overcome this problem, and to try to give the landlord an increasing share in farming prosperity, there has been a tendency in recent years for landlords to take tenanted farms in hand when they become vacant. In some cases this has proved satisfactory, but often the standard of management has deteriorated and profits have been disappointing. A

share tenancy is a compromise solution that need not deprive the landlord of the right to possession, but which relieves him of the responsibility of day-to-day management. Because the small tenanted farm has a poor future, it is a means of putting the larger agricultural units into the hands of able and energetic young men who only lack the capital to exploit such holdings. Some of the systems already in existence are set out below.

Established systems of share tenancy

In districts where farmhouse cheesemaking is traditional, it has always been necessary for there to be close co-operation between the milk producer and the farmer who makes the cheese. Close liaison is encouraged by a premium (at present about twopence a gallon) paid for the milk, and the fact that whey and skimmed milk are often returned to the producer for pig feeding. To maintain supplies of milk and to expand business, cheesemakers have sometimes bought local farms, and entered into an agreement with the tenants as follows:

1. The landlord retains the freehold of the property in his own name.
2. He joins in a partnership with the tenant to form a trading company, and that company takes a formal tenancy from the landlord. Alternatively the landlord may grant the tenant an individual tenancy, and the tenant himself then grants the partnership a sub-tenancy. This provides security of tenure to the tenant in the event of the partnership being dissolved. An economic rent is paid—in most cases between £5 and £9 per acre—but this may be varied to suit the tax position of the two parties.
3. The trading company partners jointly provide the working capital to establish, in the first year, a fully viable and stocked unit. If possible the two trading partners provide equal amounts of capital, but if the co-tenant has insufficient funds, the balance is borrowed by the partnership from the bank against security offered by the landlord. Most landlords prefer a tenant to provide at least one-third of the working capital to start the business, but less is accepted from outstanding men. Interest is paid to both partners at between 5 and 7 per cent on the capital they have introduced.
4. The landlord is not concerned with the day-to-day running of the farm, and the tenant is paid a wage (£16 a week might be a typical figure for a one-hundred-acre unit).
5. After the above charges have been made, the residual profit is divided equally between the landlord and tenant, or in proportion to the capital they have introduced.

There are many variations of the above pattern. Instead of the landlord being paid an economic rent, it can be advantageous for him to be more closely identified with the actual farming and be classed as a salaried partner. This may give him the benefit of earned income relief on the tax assessment of his remuneration. The rent payable may also be related to output achieved, i.e., the rent paid by the partnership is related to the gallonage of milk produced per acre, or as a proportion of the typical gross margin of that enterprise in the locality concerned. The latter basis of assessment for rent has many advantages over the traditional one, not only for share tenancies but also for conventional lettings. However, it is easier

to apply to specialist dairy farms than mixed or arable holdings, where receipts and output vary so much.

Advantages of share tenancies

If several farmers in an area adopt share tenancies with their landlord, it is sometimes possible for commodity purchases and sales to be arranged through a trading group which can obtain more advantageous terms than individual farmers. There is also a pooling of knowledge and experience in this direction. Junior partners on the smaller holdings gain knowledge by taking decisions after consultation with a senior and more experienced partner. Also, the junior partner can exploit and enjoy a larger unit than he would otherwise be able to occupy because of his lack of tenant's capital. From the landlord's point of view, his stake in farming prosperity is increased, but he is not involved in detailed day-to-day work. He has less responsibility than if he were to take the land in hand and employ a manager, and his chances of making an adequate profit are much improved.

Disadvantages

Because a tenant is receiving a basic wage and a maximum of 50 per cent of the profits, his ability to accumulate capital is probably less than if he were an owner-occupier or traditional tenant. It is also difficult for the tenant to improve his position unless he moves to a larger farm. It is vital that there is compatibility of business interest and personality between the partners of the share tenancy, and the tenant must not feel that he is being made to do all the work while somebody else is taking 50 per cent of the income. A tenant is normally discouraged from starting a supplementary enterprise of his own, e.g., poultry, outside the main agreement. This can lead to difficulty even if the tenant's wife or a member of his family intends to do most of the work, because there is always the danger that the tenant will spend too much of his time and energy in that direction.

Future trends

Without doubt there are other share tenancy systems in operation, and there will be many refinements as the need to improve farm structure becomes more pressing. Industry and commerce have seen rapid increases in the financial size and strength of companies in recent years, and this trend is inevitable in farming. Owner-occupiers might lease their holdings to a farming company, who would re-employ them as managers for each aspect of the farming enterprise. The manager would be a director of the main company, and would be responsible to the board for his individual section of the business. Small tenant farmers could co-operate with each other, possibly under the chairmanship of the landlord, to obtain purchasing and marketing advantages without losing their identity as individual farmers.

Any future development of share tenancies must facilitate the better use of land, capital, labour, machinery and trading opportunties, together with a pooling of management and business expertise.

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An Outdoor Pig Enterprise

N. D. Cox

FACED by the challenge of making a living from a small farm on sand land, Mr. Warner, of Waterend Farm, near Thetford in Norfolk, has developed a very successful, trouble-free system of outdoor pig keeping with virtually no capital outlay. Nearly twenty fat pigs a year are produced from each herd of thirty Large White x Landrace sows—the litter average being 9·6. Most go for bacon and 96 per cent have graded Double A. These results have not been achieved by adopting the new techniques of early weaning, controlled-environment, and virus-pneumonia-free systems that are all the rage, but merely by the simple policy of outdoor farrowing and rearing and very careful attention to the mundane details of management.

The farm is in the Norfolk Breckland, which is a vast, almost flat plain of nearly pure sand. Most of the farms here are at least 500 acres, but this is unusual in being only 75 acres in size. The natural fertility of the soil is extremely low and it does not take many days of hot sun to shrivel up the crops. Frequent grass or lucerne breaks are necessary in the rotation to maintain any sort of crop yields. The problem of what to do with this grass has been solved by Mr. Warner in using it for the pigs. The whole farm system, therefore, is well-balanced in that the pigs on the grass help to maintain fertility for subsequent arable cropping (sugar beet and two barleys) and the pigs outdoors are kept remarkably healthy and without

Mr. Warner with a healthy batch of weaner pigs.
The small, semi-circular corrugated iron hut is used for shelter

heavy capital expense in buildings. The grass used is just S.24 perennial ryegrass sown at about 20 lb to the acre, and the aim is to grow this about once every four or five years.

Breeding

The foundation of the herd is a small number of pedigree Large White sows which are inseminated with Large White semen from the Norfolk Pig Breeding A.I. Service. Gilts from these litters are carefully selected with the help of the ultra-sonic grader at 200 lb live weight, to be crossed with a Landrace boar to produce the commercial breeding herd of sows. The success of the system is obvious from the results quoted already of nearly 100 per cent Double A bacon pigs. The fat pigs are marketed through the F.M.C. and Elmswell Bacon Factory, and Mr. Warner belongs to both the Norfolk and Suffolk Quality Bacon Associations.

Sow management

The gilts are vaccinated against erysipelas at 200 lb live weight, and served with a young boar of similar size at eight months. Controlled single service is practised. The in-pig sows and gilts are run in a paddock till farrowing, and this ground is used only for one year before being ploughed, to prevent the build-up of disease. Wooden individual feeders are used, and the sows get 6 lb of meal daily at one feed. They have small, semi-circular corrugated iron huts for shelter.

Farrowing

Three to four days before farrowing the sows are moved to the outdoor wooden huts. These are home-made and although they have been in use for ten years or more, are still very sound. They are 6 ft $\times$ 8 ft square and 3 ft 9 in. high, having a corrugated iron roof with a hard-board lining. Inside there is a farrowing rail round the back and sides, and the wooden floor is bedded with hay, not straw. This is considered to be very important to provide a good, warm bed. A sack is hung over the doorway to give shelter.

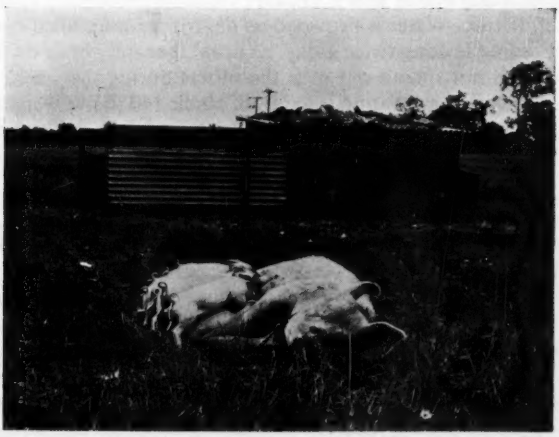
The outside run is about 16 ft × 8 ft, made up with gates with corrugated iron sheeting attached to provide some shelter.

The sows farrow in these huts all the year round. In exceptionally severe weather, particularly if there is a cold, biting wind, which can sweep across these Norfolk plains non-stop from the North Pole, a few bales of straw are put around the outside to give added protection. The aim is to farrow in groups of four, and the four huts are placed in a paddock 55 yards square. This is very convenient, the sides being the length of a roll of pig netting, and the four litters are a conveniently-sized batch of pigs to manage.

The sows are not interfered with or watched during farrowing. In Mr. Warner's view, if this had to be done it would be a confession of failure, as he considers the sows should be able to mother the piglets perfectly satisfactorily themselves. About a week after farrowing the sows are harnessed and tethered with a 30 ft chain. Again, the paddock is large enough to enable a chain of this length to be used without the sows interfering with one another. For the gilts, unused to the practice, there is an interval of two days between putting on the harness and tethering. The harness is put on in the evening, when the gilts are fairly quiet. This practice means the gilt has time to get used to the idea and not get over-excited and perhaps harm her litter. At this time the outdoor runs are removed and the piglets are allowed to run free in the paddock.

Weaning

Weaning is carried out at eight weeks in the normal way by removing the sows from the weaners, leaving them in the paddock to which they are accustomed. The huts are removed to a fresh site and the weaners have a small, semi-circular corrugated iron hut about 8 ft long by 8 ft wide for shelter. This has no floor, straw being used for bedding—about one bale a week. There is no door either, but in severe weather a baffle of straw bales may be put up. These huts are large enough for four normal litters, about forty pigs, but if there are exceptionally large litters they can easily be extended by another semi-circle of iron sheets. The weaners are kept in this paddock summer and winter until being moved to the fattening house, which is a converted deep litter house.



An example of a home-made outdoor wooden hut used for farrowing

The huts are cleaned down and burnt out with a blowlamp between each farrowing and a fresh site is used each time. The same ground is never used twice in a year. This may seem extravagant to some, but it does help to keep the pigs free of disease and losses are negligible. The output is at about £300 to £350 worth of weaners per acre.

Feeding

All rations are home-mixed and the cost is kept down to £30 a ton or under. The advice of N.A.A.S. nutrition chemists is frequently sought and the rations are designed to be easily digestible, as it is considered that digestive upsets are one of the main causes of trouble to pigs. The rations used are the following:

	Sow	*Creep*	*Weaner*	*Fattener*
Barley	10	6	10	10
Wheat	3	2	2	2
Maize	1	2	1	1
Flaked maize	—	2	—	—
Middlings	2	2	3	3
Bran	1	2	1	1
Soya bean	1½	—	1½	—
Beans	—	—	—	2
Fish meal	1½	—	1½	1
Baby pig conc.	—	4	—	—

Minerals and vitamins are added and the fatteners have a high copper mineral.

The in-pig sows are fed 6 lb of meal daily given at one feed a day. Just before farrowing, when the sows go into their huts, this is cut down to 4 lb with 2 lb of bran added. In addition, a spoonful of liquid paraffin is fed daily till after farrowing. This keeps the bowels open, which is a vital factor for successful farrowing and subsequent milk production. When two or three days old, the piglets are given an iron injection and have their teeth cut to encourage gentle sucking and so stimulate the early flow of milk. During suckling the sows will get 15 to 18 lb of meal. Creep feed is introduced gradually at three weeks. Circular iron troughs are used and these are moved about in the pen approximately once a week to prevent fouling of one particular place. This is another valuable precaution against the development of disease. Water is provided *ad lib.* from a tank filled once daily in each pen. Feeding is done twice a day, as usual, but only once on Sundays. The missed feed is not spread out over the others during the week.

The weaner's ration is fed until about 140 lb live weight, when the fattening ration is introduced. This is restricted to 5 lb daily and water is fed at the rate of 2 gallons per 10 lb of food fed.

Disease

By adopting this system the pigs are remarkably healthy and suffer from few digestive upsets. No antibiotics are included in the ordinary ration but if there does happen to be a scouring pig it is taken away to a 'hospital' pen at the main buildings, where it receives an antibiotic injection plus a dose in the drinking water. This practice prevents the spread of disease. The bill for veterinary charges and medicine comes to only £100 a year and this includes the erysipelas injections and castration, which are done by the veterinary surgeon at weaning.

Results

It is quite a sight to visit the farm on a cold, winter's day and see the large litters of healthy pigs frisking about in the field, entirely oblivious of the weather. Provided that the pigs have a warm bed the abundance of fresh air seems to suit them. Mr. Warner has built up his system by observing simple principles of hygiene, careful attention to detail, and maintaining the pigs as much as possible free from digestive troubles. This has resulted in an extremely high production per sow and his breeding has resulted in phenomenally high grading standards for a commercial herd. Furthermore, very little capital expense is involved. It is encouraging that by adopting this simple system pigs can be produced efficiently but, of course, one of the important factors of the system is the fact that the soil type and land is suitable, being light and free-drained.

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Farmer Production and Marketing Groups

J. M. Ewing

CHANGING situations and circumstances frequently bring new thinking to bear on the problems of the day. Such is the current position in farmer group development. In recent years there has been growing interest in group activities, and this has perhaps been highlighted by the rapid growth, in both numbers and size, of farmers' buying groups. Alongside this growth has been the more gradual, though none the less significant, emergence of production and marketing groups. It is this latter move, bringing with it a closer integration of production with marketing, that is the more far-reaching. The innovators and pioneers in this field have demonstrated many

of the advantages and problems associated with group formation and operation, but the diversity of the organizations so far established leaves room for setting out some of the guiding principles of group formation. That few, if any, groups will follow exactly the same development pattern is quite clear, but nevertheless there is still likely to be a considerable amount of common ground between them.

The problems

In the early development stages two features stand out as being of prime importance and must be regarded as essential features of any group formation. Firstly, the activity in which the group plans to engage must be clearly defined to the potential membership. Secondly, the likely participants must be of high calibre. In defining the activity, the group must demonstrate the likely gain to its prospective members, whether it be solely financial or coupled with less clearly definable advantages. Added to this the disadvantages should be catalogued and their significance carefully considered. Where the advantages at first sight are difficult to define, as might well apply in an entirely new field of activity, then careful preliminary research is essential.

Finding the nucleus of founder members to launch a group activity can present many problems, though the participants can and do emerge in a variety of different ways. Clearly it is of prime importance that they do emerge to develop a sound project. These men must exhibit leadership, combining with this a desire to co-operate and willingness to devote time and effort to the group. That the agricultural industry has these men in its ranks is beyond dispute, though much talent still remains to be tapped and developed.

Group discipline

To function efficiently, any organization requires clearly-defined guide lines and farmer groups are no exception. The most important feature of the development period of any group is the formulation of working rules and discipline. Many, if not all, of the likely members will find the acceptance of discipline strange and perhaps to some extent distasteful, but its importance cannot be over-emphasized. Success is far from certain where the operations are based on 'old boy' arrangements and these, or similar ties, can readily break down under pressure. In a buoyant production and trading situation loyalties are seldom under any pressure, but should temporary difficulties beset the organization, then the need for discipline becomes very clear.

One of the more important disciplines is that relating to finance, particularly where the group operates with little or no financial reserves. As many groups are likely to operate on this basis, the requirements in this sector must be clearly defined and adhered to rigidly. The ease or difficulty in setting out the discipline in this field is largely dependent on the financial integrity of would-be members coupled with the initial selection of the founder members.

With the establishment of group discipline must come a change in members' outlook. The growing group must create a feeling, and produce an atmosphere, in which there is a strong sense of participation and belonging.

The small farm

There is perhaps one further facet of group formation and activity which causes concern and provokes considerable discussion in and out of farming circles; this is the place and role of the small farm in the group pattern. To some extent the benefits which accrue to the small farm business are less than those obtained by larger units. This is due to the fact that, despite grouping, a very considerable number of units are still involved and, in consequence, the economies are less significant. This should not be a bar to small businesses participating in group activity, and indeed there are many activities in which they can very effectively engage. This is particularly true in the field of production grouping.

The time scale

The time taken to formulate and develop a group activity can frequently be considerable and it will perhaps help the reader if some indication is given of the time involved. This can be illustrated from recent experience by referring to the development of the Suffolk Potato Producers Ltd. A period of two to three months elapsed between the conception of the idea and its acceptance as a basis for development. The subsequent exploratory stage, which saw the building up of working rules and discipline, lasted nine months, and involved much investigation and many meetings and discussions. Thus the total time extended to approximately twelve months. Where feasibility studies are likely to be involved the time factor may be appreciably increased. Although there will be this considerable variation in time between groups, it is of paramount importance in each instance that every aspect of the project be subjected to very thorough investigation and discussion before any final commitment is made.

The problems outlined so far are, in my estimation, common to all groups. It is only variation in the type of activity envisaged which will produce different detail in the final discipline.

The possibilities

In attempting to appraise the likely future of groups, one is drawn firstly to speculate on the probable impact of pending legislation. Indications are that Government proposals in their present form will stimulate activity in the group field by offering financial assistance over a much wider field than is currently covered. These grants should generate the development of ideas along the lines of production grouping and will encourage interest in projects which may well have been suppressed through high cost or the unusual nature of the idea or proposed venture. There is no doubt that there is ample scope for a very considerable growth in group activity, but the emergence of rash and ill-considered groups would be a disservice to the individual farmer and the industry as a whole. This more than anything would damage the move towards greater co-operation in which both farmers and technicians carry a heavy responsibility.

In offering producers economies in production, and the presentation of quantity on the market, groups are fulfilling only part of their function. With these features must come improvements in quality, presentation and, where appropriate, continuity of supply. In this situation established market agents can, and will, respond to dealing with a better-organized farming

industry. Fears are frequently expressed about the possible loss of independence and identity in the group sphere, but in very many group activities this certainly need not occur. Collaboration in quality production, the achieving of better market outlets and gaining the benefits of lower production costs far outweigh this doubtful disadvantage. It is also equally true to say that where a producer is supplying a quality product to a group, even though the quantity may be small, he is doing more to establish his identity and voice in production and marketing policy than all too frequently applies in present haphazard trading.

Fields for development

Possible fields for such activities might be the development of single machine syndicates to cover a range of varying machinery, lowering of capital investment by extension of the centralized building theme, and an increase in 'group specialization' in the crop and livestock fields. Here the breakdown in the production chain affords opportunities for improving techniques by specialization, and frequently enables the concentration of certain lines of production in suitable parts of an area or indeed the country. This implies that co-operation need not take the form of groups working in isolation but, given the right leadership and co-ordination, groups can serve one another with very considerable advantage.

The horizon for group development need not be confined to national boundaries and the Continent can, and does, offer a stimulating challenge to a dynamic and well-organized industry. The future growth of farmer production and marketing groups will reveal many problems, demonstrate innumerable opportunities and present many a challenge, but there is no doubt that the industry can meet this challenge. That it must do so from a well-conceived group programme is none the less certain.

The author of this article is **John M. Ewing, N.D.A., N.D.D.H., C.D.A., C.D.D.**, who is Senior District Adviser for the N.A.A.S. in the Mildenhall district of West Suffolk. He is also a member of a N.A.A.S. Co-operation Study Group in the Eastern Region.

Chemicals in Agriculture

A feature containing articles on the use of chemicals on the farm will appear in *Agriculture* shortly.

Intensive Cereal Growing

Weed Control

R. G. Hughes

THE control of weeds has always been regarded as one of the principal reasons for rotating crops. It is, however, the rapid developments in weed control methods in recent years, besides other improved husbandry techniques, that have encouraged the trend towards the intensification of cereal production on many farms today. Weeds compete with crops for water, light and nutrients, thereby influencing the important relationship between crop vigour and disease or pest potential. Perennial grass weeds complicate this relationship by being hosts for soil-borne diseases. The cereal grower cannot escape the impact of weeds on profitability. He may learn to cope in spite of them, but he cannot waver from continual warfare against them.

Broad-leaved weeds

Surveys carried out in several regions during the last two years have indicated that the regular use of herbicides in cereal crops during the last decade has considerably influenced the density and composition of broad-leaved weed flora. Direct competition with the cereal crop nowadays is seldom the dominant factor influencing yield of grain harvested. It is the effect of broad-leaved weeds on the efficiency of harvesting that matters most in terms of yield in many cereal fields today. The choice of herbicide and timing of application must, therefore, be geared to the weed species that are most likely to cause losses through delays in harvesting and bottlenecks at the conditioning plant, particularly where a large acreage of cereals is involved.

When lodging is not a problem and harvesting progresses with ease, the application of herbicides for broad-leaved weed control could result in a negative response. All herbicides have some effect on the crop and in a situation where there is a fine balance between crop vigour and cereal disease this could be critical. There may therefore be situations in intensive cereal production where the use of a herbicide for broad-leaved weed control is best omitted. Alternatively, the least toxic chemical should be used or rates of application reduced below those normally recommended. When, for instance, take-all disease is expected to exhibit its greatest effect in continuous cereal production, the aim should be merely to suppress broad-leaved weeds consistent with minimum herbicide toxicity to the crop. Chemical manufacturers must also recognize the interrelationship of herbicide toxicity with other factors limiting crop growth when issuing recommendations for herbicide

use. Even more important is the need for precision in application of herbicides. Calibration of individual nozzles, a sound mixing routine and a systematic field marking technique are essential requirements if the use of herbicides in present-day cereal production is to lead to improved sound grain yield.

Perennial broad-leaved weeds can become a serious problem in continuous cereals. Perennial bindweed, coltsfoot, creeping and perennial sowthistles develop their aerial growth in late spring or early summer, when cereal crops have progressed beyond the stage for safe application of herbicides and when wheeling with ground sprayers could cause considerable crop damage. In the absence of competition from annual weeds these deep-rooted perennials thrive and any depression of crop vigour by soil-borne or foliar disease will encourage their spread. Deep tillage in stubbles to allow for desiccation of the underground parts by wind or other agency can reduce the infestation. It may, however, also be necessary to employ translocated herbicides that will materially reduce the regenerating capacity of the roots when applied to undisturbed stubbles.

Annual grass weeds

It is estimated that 150,000 acres of cereals are moderately to severely infected with blackgrass each year. This weed used to be associated with continuous winter cereal cropping on heavy land. No longer is this so. Blackgrass now constitutes a problem on many soil types and it also germinates freely in early-spring-sown cereals. A survey of blackgrass infestations carried out by the N.A.A.S. in conjunction with the Botany Department at Rothamsted Research Station during 1966 may shed light on these changed habits when records are analysed. The intensification of cereal production is certainly increasing the incidence of this competitive weed. Delayed sowing to enable the first flush of seedlings to be destroyed by cultivation in the autumn is one method of reducing infestations, but delayed emergence and retarded root growth in winter cereals can allow soil-borne disease to gain the upper hand. Controlled burning of stubbles immediately post-harvest will also help eradication but stubble cultivation, on the other hand, is likely to aggravate the situation. Burial of seed encourages prolonged dormancy and irregular emergence which could complicate any additional chemical control measure.

We now have an increasing range of herbicides available for selective control of blackgrass in cereals offering a choice of pre-sowing, immediate post-sowing, early and late post-emergence application. With any of these techniques, however, crop vigour is an important ally governing the efficiency of control and this, in the context of close cereal cropping, will demand that the crop is sown under optimum conditions encouraged by adequate nitrogenous manuring, and also that every care is taken in applying the correct dose of herbicide to minimize crop toxicity.

In some parts of the country intensive cereal production, coupled with a recent sequence of wet seasons, has encouraged other annual grass weeds, such as rough-stalked meadow grass, particularly in winter cereals. Self-sown Italian ryegrass can also become a nuisance weed in cereals. These not only propagate from seed but also vegetatively from small clumps that survive stubble cultivations and indifferent ploughing. Rotary cultivation under dry soil conditions or the use of a cheap chemical desiccant, e.g., paraquat, before stubble ploughing can assist in eradication.

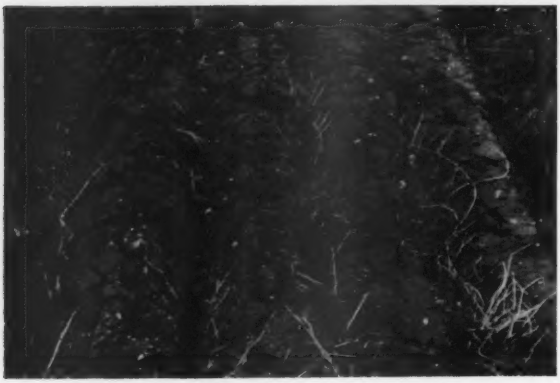
Stubble cultivation using chisel plough which has been set at shallow depth after initial rotary cultivations

Wild oats

The first principle in weed control is the use of clean (crop) seed. Wild oats are spreading at an alarming pace to all parts of the country. It may be that more strict standards for cereal seed multiplication could have stemmed this spread, but birds are probably also guilty of spreading the weed within localities. The intensification of cereals has, without doubt, aggravated the problem and led to situations where the annual application of soil-applied or post-emergence herbicides has become part of corn growing. There are, however, areas remaining where systematic hand roguing, followed by complete destruction of the rogues, could still be a worthwhile procedure. Delayed sowing of spring cereals, particularly the newer spring wheat varieties, such as Kloka, does afford an excellent method of killing the early flush of spring wild oats but on the thinner soils loss of moisture, even following shallow cultivations, could have a larger influence on cereal yield than competition from wild oats. The limitations on stubble treatment mentioned in relation to blackgrass control apply also, in general, to wild oat control. Where couch grass is also a problem, however, there is need to define priorities, and couch is undoubtedly the greatest threat to profitability from cereals.

Perennial grass weeds

In the nineteenth century true couch—*Agropyron repens*—was often called 'creeping wheat grass' and it certainly creeps into many wheat fields today. The rhizomatous grass weeds including the bent couch (*Agrostis gigantea*), which is the most common species in southern counties, are carriers of soil-borne diseases, particularly take-all. Their presence in cereals can also aggravate the toll from soil pests such as cereal root eelworm. Ploughing as a means of preparing land for cereals is being challenged today, but it is the failure to deal with couch grass that is restricting the development of new techniques such as minimal cultivation. The chemicals available now for couch control are at best only aids to the more traditional cultural means of dealing with perennial grass weeds. The scope of this article does not allow for a full appraisal of these. A rigid adherence to one technique will seldom solve couch problems, and there is often need to exploit a combination of proven methods all aimed at maximum disturbance of the weed. Forward planning is also essential. In systems of close cereal cropping couch should be



Couch regrowth in plough furrow slice—upper half sprayed with paraquat before seedbed preparation

disturbed at the earliest opportunity following harvest and the disposal of straw. This will call for action whilst harvest is in progress on other parts of the farm. Two or three passes with a rotary cultivator, during reasonably dry soil condition, each separated by an interval to allow couch regrowth and finally followed by efficient ploughing, is a worthwhile routine for couch control in stubbles. When adverse weather conditions interfere with this process chemical treatment with dalapon, amitrole or T.C.A. to the regrowth of couch can give satisfactory control, provided good ploughing follows after a 4–5 weeks interval. On land that is not amenable to rotary cultivation the chisel plough, provided it is not set too deep, followed by tine cultivation, will also provide the necessary disturbance and allow the elements to desiccate the underground rhizomes.

In the north and west late harvesting of cereals is a very real handicap in dealing with couch (wicks) in stubbles in between cereal cropping. Here there must be a good deal of reliance on efficient stubble ploughing after exploiting the best methods of removing surface trash. A desiccant, e.g., paraquat, which has low soil residual activity, can be used to disturb the growth of couch in the furrow slice just ahead of seedbed preparation in the spring. The final stage in any plan for couch control in intensive cereal cropping involves the selection of a vigorous cereal variety that will respond early to generous manuring when sown under optimum conditions. In this respect the modern feeding barleys, sown early in the spring, are preferred to wheat or oats. It is often a fallacy to delay spring sowing in the hope of effecting a worthwhile control of couch at this time of the year.

Avoiding crop damage

Weeds are limiting factors governing success in intensive cereal production today. Failure to control weeds can aggravate disease and pest problems associated with cereal monoculture. The measures adopted for weed control must, however, dovetail into the pattern of husbandry that is essential for maximum crop vigour. Modern herbicides can play an important role alongside more established cultural techniques, but only if they are used judiciously and with the precision required to provide the minimum of crop toxicity.

This article has been contributed by **R. G. Hughes, B.Sc.(Hons.)**, University College of Wales, who is the N.A.A.S. Crop Husbandry Adviser for the South-Eastern Region.

Close Companies

G. H. Camamile and E. S. Carter

MANY farms operate today as companies. These are usually family companies or under the control of a very few people, and such closely controlled companies have, for a long time, been subject to various special tax rules. When a company controlled by five or fewer people had not distributed a reasonable amount of its net income (so that it bore surtax in the hands of the shareholders) the Inland Revenue could make a surtax direction. There was also a limitation of the amount of directors' remuneration which was allowed in computing such a company's liability to profits tax.

Under the new corporation tax legislation introduced by the 1965 Finance Act there are similar, but more extensive, rules for companies under the control of a few people. This Act creates a new class of company for taxation purposes—close companies—to which special provisions apply.

The tests for determining whether or not a company is a close company, and the definitions of some of the chosen words used in these tests by the Act, like 'participator', 'associate', 'loan creditor', 'control' and 'director', are detailed and elaborate. If any reader wishes to seek more detailed information he should refer to page 35 in the booklet on corporation tax obtainable free from the office of any District Inspector of Taxes. The whole new realm of corporation tax is one in which skilled professional advice is indispensable, as nearly all 'one-man' and family companies are close companies and it normally makes no difference if some, or all, of the shares have been put into a trust.

The most significant consequences for 'close' farming companies are as follows:

Loan interest

Loan interest paid to a director (who has some shares or other interest in the company), his close relatives or the trustees of a family settlement, is not allowed as a deduction in computing corporation tax. Rent for the use of a farm, provided it is at a commercial level, is deductable even though it is paid to such a director or people associated with him.

Loans

A loan made to a person who has an interest in the company, either as a shareholder or in certain other ways, costs the company a sum of income tax until the loan is repaid. If a loan of £1,175 is made to a shareholder, then, with income tax at 8*s.* 3*d.* in the £, the company has to pay the Inland Revenue £825 (8*s.* 3*d.* in the £ as against a loan of 11*s.* 9*d.* in the £) as the relevant tax. When the loan is repaid, the Inland Revenue will refund the tax.

Directors' pay

There are some close restrictions on the amounts which can be deducted for directors' remuneration in calculating the company's liability to corporation tax and these will be dealt with later in the series.

Distributions

Unless the company needs to keep more of its resources to meet its own financial requirements, it may be assessed for income tax on a proportion of its undistributed profits which remain after corporation tax has been paid. Surtax assessments based on an apportionment among its shareholders will follow. This special subject will be covered in the article dealing with distributions in close companies.

Despite all these factors, there is still a point at which, either because of the high rates of surtax in the upper income brackets, or for other reasons, it is worth while farming through the medium of a company. Where this point is reached is a question to be determined from the facts of each particular case, which should be carefully examined before a decision is taken.

(This is the sixth note in the series 'Tax in Perspective'. A seventh note will appear in next month's issue of *Agriculture*)

To be published shortly for the Ministry of Agriculture, Fisheries and Food by H.M. Stationery Office:

Horticulture in Britain — Part I, Vegetables

Obtainable from Government Bookshops (addresses on p. 104), or through any bookseller, price 57*s.* 6*d.*

The book includes technical sections on climate, irrigation, mechanization, control of weeds, pests and diseases. There are a number of appendices dealing with the advisory services and other aspects of the Government's concern with the horticultural industry, financial assistance to horticulture, and marketing co-operatives. Customs duties on vegetables, household purchases and consumption, and other information relevant to horticulture, including statistics, both in Britain and in Europe, are also covered.

This volume provides a comprehensive background of comparative statistics on vegetables and should be useful to a wide variety of interests concerned with horticulture. It will be followed later on by a second volume dealing with fruit and flowers.

Zero-Grazing of Dairy Cows

K. V. Runcie

STOCKING rate of cows to the acre is one of the major factors affecting the profitability of milk production. The higher this is, the greater the overall profit. This has led to ever-increasing amounts of fertilizer being applied on grass, more cows being carried per acre and an increasing problem of how to utilize the grass properly as the amount refused by contamination increases. The cow becomes its own worst enemy in the circumstances. Alternation of grazing with cutting for hay or silage will help. Many farmers think the next move under these circumstances is to move to zero-grazing or the cutting and carting of grass to stock housed indoors or in semi-open yards. On farms practising intensive feeding of arable by-products or barley straw plus barley and a supplement, the acreage of grass is small, amounting to perhaps half an acre per cow for summer grazing.

Production from this type of grass, grazed 5–6 times in the season, is likely to fall off as autumn approaches. Despite topping, grass will be refused by cows. If cows are forced to eat this fouled grass then their intake and milk production are likely to drop. This may not be important with autumn-calving cows as yield has already fallen and they will be dry at the worst period—August and September. However, spring and late-winter calvers are at a more vulnerable stage of their lactation when a reduced intake of grass will result in a fall in milk yield. When stocking rate has reached this level two possibilities exist for maintaining yield, (1) feed additional concentrate foods, or (2) zero-graze the animals, taking them off the pasture completely, so giving it a chance to produce its maximum.

Advantages and disadvantages

Trial work on zero-grazing was carried out for seven years at the Edinburgh School of Agriculture between 1956 and 1962. The answers to many

questions were found. With very much higher levels of stocking the work may be revived. The advantages claimed for zero-grazing are:

1. Improved utilization of grass as tramping and fouling is avoided.
2. Better control over feeding as the quantity and quality of grass can be varied with the requirements of different classes of stock.
3. The whole farm can be used for dairy cows.
4. No piped water or fences are required.
5. No time is spent moving cows to and from the field. This can easily amount to 1 hour per day.

Disadvantages are:

1. Increased machinery and labour costs for cutting the grass.
2. Increased labour to clean yards.
3. Increased bedding requirements as cows are housed for 12 months.
4. Greater reliance on machinery for feeding cows.
5. Difficulty in maintaining correct quality of the grass when cutting.

Zero-grazing is an old-established practice. Experiments have been carried out in many parts of the world and zero-grazing of lucerne is a common practice of many of the town milk supply farms in the United States. It is, of course, supplemented with concentrates.

When to zero-graze

Zero-grazing is not a practice which should be considered by the majority of dairy farmers at present. In most cases there is ample margin for improvement with the normal conventional systems of grazing management, without making them more complicated. Increased use of fertilizer, the use of the electric fence in a system of strip or paddock grazing, and the alternation of grazing and cutting are all practices which will improve the stocking rate. There are circumstances under which zero-grazing will be justified:

1. If the stocking rate is high, say $\frac{1}{2}$ acre/cow or less for the summer. By this time refusal of grass due to dung is a problem.
2. Farms where the fencing or the water supply are poor. This then is one way to take the cows round the farm!
3. Farms where much of the land is too distant from the buildings for grazing. It is, however, worth examining if the level of production on the fields near the buildings can be increased to avoid the daily jobs of cutting and carting.
4. Large herds may have to walk too far for grazing. In this case specialized equipment may be justified.
5. A shortage of grass can prove the value of zero-grazing, as grass can be effectively rationed to different groups of animals.
6. Unsuitable grazing conditions for part of the year can limit grass production by grazing. Cutting and carting the grass enables these areas to be effectively utilized by dairy cattle.

Results to be expected

The milk yield of individual cows will not be greater than in normal grazing. In fact there is a greater likelihood that individual production will be less, as the quality of grass fed is poorer than under grazing conditions. There is a temptation when cutting grass to let it get longer as a load is obtained more quickly. Probably the best machine for zero-grazing is the gang-mower as this has a wide cut and it will not efficiently cut grass that is too long and stemmy.

There are also problems with feeding the grass. Cows do not like stale food and some grass which is turned over and over in the trough will be refused. Heated grass which has been left in a trailer too long will again lead to refusal and reduced intake. Cutting once a day and offering grass twice a day seems a reasonable compromise. To get as good results, the same quality of grass must be fed as that obtained under grazing. It is on this point that so many farms which have zero-grazed have made errors in the past.

Milk quality

Feeding good quality grass will result in the production of milk with good butterfat and solids-not-fat. Our trials have shown 12·6–12·9 per cent T.S. Only in one trial did the zero-grazed group fall below the group of animals grazing. This fall occurred at the end of the trial when the grass was stemmy and the intake fell due to falling digestibility. Under these conditions the grazing animal can carry out some selective grazing and keep up the quality of its intake. The zero-grazed animal has little chance to do this.

Intake of grass

The quantity of fresh grass eaten will be in the order of 150 lb/head/day but in the spring, when it is highly digestible, it may be as high as 200 lb/day. The intake of grass can be affected by a number of factors. The more stemmy the grass the lower the intake and the digestibility. Some evidence suggests a lower intake of flail-cut grass compared with long grass. Bad operation of the cutting machinery which causes the contamination of the grass will reduce intake. A shortage of trough space, a trough of poor capacity and awkward access to the troughs will all result in reduced intake.

Stocking rate per acre

This is the main reason for zero-grazing, and an improvement of at least 15 per cent can be expected. Greater savings could be achieved by restricting the uptake of cows on lower milk yields, only cows at higher yield levels receiving grass *ad lib*. The quantity of grass to be fed will be fixed by what is refused. There should be grass left for consumption in the morning after milking. A stocking rate of two cows per acre should be easily obtained.

Breeding performance

There is no evidence to suggest that the cows kept in and zero-grazed breed less well than those out grazing. As cows in yards are more easily seen to be in oestrous, it is possible for the breeding performance to be slightly better.

Clinical troubles

If zero-grazed cows are walking on concrete, then there is likely to be less trouble than with animals grazing. If cattle are kept in fully-bedded yards, feet troubles are likely to be very prevalent. Metabolic disorders such as milk fever or hypomagnesaemia have not appeared to be affected by the system. Cows kept inside and zero-grazed put on more condition than those out grazing.

Bedding requirement

As animals need to be housed for the whole year the bedding requirement will be doubled. This may be a problem where straw is used. The use of cubicles will avoid this but provision must be made for handling slurry all through the year. During the summer this can be applied on silage ground or on grazing when grass is short. If the slurry is spread evenly when the grass is short, cows will graze this grass. If, however, it is applied when the grass is long and uneven then considerable refusal of grass will take place. Grass may be fed to cows in a paddock alongside a concrete feed area. This is practicable in areas of low rainfall but would not be advisable over the greater part of the British Isles.

Method of feeding

Grass should be cut daily or twice each day and the grass offered twice daily. Feeding may be from a trough or from a self-feed trailer. A tombstone feeder is necessary in front of the trough which requires sufficient capacity to hold 75 lb of grass. Alternatively, for a small number of cows a self-feed trailer may be drawn into the yard so that the cows feed along either side of the vehicle.

Costs

Costs will vary with the number of cows and who cuts the grass. At a minimum where grass is cut by the dairyman this offsets the time spent taking cows to and from the fields and setting electric fences. Also the normal silage equipment will be used. The additional costs are fuel for feeding and cleaning and the cost of bedding. For 60 cows this may amount to:

	£
Fuel	70
Bedding (with cubicles)	15
	85

On a larger scale special equipment such as forage harvester and side-delivery trailer may be used and the feeding done by a tractorman. Additional costs due to zero-grazing are:

	£
Maintenance of equipment	150
Labour @ 10*s.* per day	90
Fuel for cutting and cleaning	70
Bedding (strawed yard)	150
	460

Most farms will fall between these two figures. Whether this is economic will depend on the farm circumstances, its present level of stocking and what is done with any acreage saved.

Zero-grazing is a demanding job which must be done at the same time each day in all weathers and in spite of machinery breakdowns; otherwise milk yield will suffer. It is not a practice to be embarked on lightly. Where higher stocking rates are required then all other possible avenues of improvement must be investigated first. As these will generally give a considerable rise in output the number of farms which can justify zero-grazing at present is likely to be small.

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The Ministry's Publications

Since the list published in the January, 1967, issue of *Agriculture* (p. 43), the following publications have beed issued.

MAJOR PUBLICATIONS

Experimental Husbandry No. 14. December 1966 (New) 8*s.* (by post 8*s.* 7*d.*)

Experimental Horticulture No. 16. December 1966 (New) 10*s.* 6*d.* (by post 11*s.* 2*d.*)

ADVISORY LEAFLETS

(*Price 4d. each—by post 7d.*)

No. 174. Gout Fly (Revised)

No. 276. Club Root (Revised)

No. 422. The Use of Chemicals for Hand Cleansing of Dairy Equipment (Revised)

No. 479. The Coypu (Revised)

No. 545. Potato Gangrene (New)

The publications listed above are obtainable from Government Bookshops (addresses on p. 104), or through any bookseller.

A Method of Producing Bedding Plants

A. P. and J. S. Coutts

At their nurseries in Cheshire, the Coutts brothers produce twenty thousand boxes of bedding plants each spring and production is still rising due to careful planning and adoption of new techniques.

For ten or twelve years we grew bedding plants more or less conventionally, on a small mixed nursery that had been built up over the years in a very haphazard fashion by the previous owners. During this time we were continually planning what we would do if we ever got the chance to start from scratch. Two years ago this chance came and we grabbed it with both hands. We bought a pasture field just over two acres in extent, close to the markets we aimed to supply.

The objective

We are strictly wholesale, and bedding plants are the main line. All other crops have to fit in with these; if they do not, they are not grown. Our pricking-out season extends from the beginning of February to the first week in May, a period of fourteen weeks, or, working a 45-hour week, 630 hours. Therefore, for every box per hour increase in speed an extra 630 boxes per season per man can be produced.

The objective is to spend as much time as possible pricking out and to reduce all other work to a minimum, and this is done by work study or automation. We have divided production into a series of interrelated parts, i.e., compost, seedlings, pricking out, growing on and hardening off. The compost we use for pricking out is University of California 1 mix, which can be stored indefinitely. It can be mixed in January and stacked under cover, it does not need steaming, and does not vary with the quality of the loam. Seed is sown in U.C.D. 1 because seedlings are very easily removed from this compost, which speeds pricking out.

Applying work study

A work schedule is prepared in December showing work to be done each week, i.e., seed to be sown, number of boxes to be pricked out, and which

Stuart Coutts (left) and his brother Arthur busy pricking out

boxes of plants are to be hardened off. To ensure a smooth flow of work, it is important that this schedule is strictly adhered to. This is only possible by having absolute control over the growth of seedlings up to pricking out, and by work studying each job so that the time required for every operation is known in advance. By trial and error, and a set of seed measures, we can now sow the correct amount of seed into each box to produce 15 boxes of pricked-out seedlings. Seed is dressed with Captan and germinated under mist with a bottom temperature of 75°F and an air temperature of 50°F.

After germination, seedlings are grown on in a growing room under fluorescent tubes. This ensures that the seedlings will be ready on the day required, regardless of outside weather conditions. If seedlings are in the box more than a fortnight from sowing, they are watered with a weak feed of potassium nitrate. The aim is to produce a seedling with cotyledons as large as possible, with a rooting system as small as possible. Experience has shown that this speeds pricking out, reduces root damage to a minimum, and enables the seedling to get away quickly.

Mobile glasshouses

We decided to use mobile glasshouses because carrying boxes of plants about the nursery does not add any value to the finished article. Each house holds 900 boxes of plants, which is two days pricking out, and these are stood down in the glasshouses in frame widths with the frame baseboards in position. When the time comes for hardening off, the boxes are quickly and easily covered down with frame lights and the mobile glasshouses rolled off to the next site. When it is realized that 900 boxes weigh about three tons and that normally they have to be picked up, moved out of the glasshouse and put down in frames, the advantages of mobile glasshouses are obvious. The glasshouses are on five moves and are 20ft wide with three single-span Dutch light frames apiece. Each house holds 900 boxes of plants, which is two day's work pricking out. Each group of three frames is wired to an irrigation sequence controller with a spray line down the middle of each frame so that watering can be done without removing the frame lights. The houses are heated with oil-fired hot air blowers, and these can easily be moved with the houses.

Pricking out

Speed at pricking out is most important, as only what has been pricked out can be sold. Fortunately, this operation lends itself to work study and many improvements can be made by small alterations in techniques. We sit down with the table between us in the path between two frames; a truck-load of seed trays is in the centre frame alongside. As each box is pricked out it is put in the frame on the other side of the table. The bottom box is in its final position, five other boxes are stacked on top, six boxes fitted across the width of the frame. This means that one-sixth of the boxes are already in their final positions. The boxes are left stacked overnight and then put down and given a starter feed of calcium nitrate. On the pricking-out table, boxes are propped up sloping towards the operator, with hand movement kept to a minimum. This reduces fatigue and enables high speeds to be maintained over long periods. Pricking-out speeds differ with the variety, but we both do at least 200 boxes per day. On occasions we have both done 40 in an hour. It seems likely that far higher speeds are possible. Like the 'four-minute mile', once attained, then others found it possible.

Nitrogenous feeds

The plants stay in the glasshouses only about a fortnight, after which the mobiles are rolled off and they are covered with frame lights. The frames are sloped towards the west. This makes sure that they catch the last of the evening sun and go to bed warm and, in case of frost, do not thaw out too quickly in the morning; a slow thaw does much less damage. The hardier varieties are done in the first two moves and kept growing slowly. As there is very little nitrogen in the compost, a very hardy plant can be produced which stands the bad weather. Then, two or three weeks before selling, continuous feeding with weak nitrogen produces a very acceptable plant. The less hardy varieties and later batches are kept growing from pricking out with nitrogenous feeds with the aim that all lines are available at all times during the selling season.

Reducing costs

We feel that we have not yet reached maximum production with two men. With more glass and more work study, something in excess of thirty thousand boxes should be possible. Our aim is to increase production and reduce costs per unit, because we do not forget that bedding plants are a luxury that the buying public could do without; they can always plant roses, perennials or even concrete flags. Wholesale prices must be kept down to give retailers a worthwhile margin.

Disposal of Farm Effluent

A fresh look at pollution by farm drainage in the light of the Water Resources Act, 1963

Introduction to a series **H. C. E. Gatehouse**

IT is now some eighteen months since river authorities began to exercise the powers and duties placed upon them by the Water Resources Act 1963 to conserve, re-distribute, or otherwise augment and secure the proper use of the water resources of their areas. The broad purpose of these powers is to ensure that water is ultimately available to all who want it in quantity sufficient for their reasonable use and of acceptable quality. Many agricultural users will have already been concerned to secure their supply by making application under the Act for a licence to abstract from surface or underground sources.

New frontiers in river management

It is, then, both timely and fitting that the problem of disposing of that water after use should be reviewed in the pages of *Agriculture*. On the farm, the tasks of providing a supply of good, clean water and disposing of the unclean waste may be seen as two separate operations. From the viewpoint of river management they are two aspects of the one problem of maintaining in balance the dual function of streams as sources of water supply and as the natural drainage channels of the country. The pressures upon both functions are increasing at a rapid rate. Rising population, improved standards of hygiene, new industrial processes and modern agricultural equipment, e.g., spray irrigation, create new demands for water. In most cases these in turn give rise to fresh problems of effluent disposal and heavier pollution loads on streams. Both influences are at their most acute in warm dry weather when stream flows are at their lowest.

The self-purification power of any stream varies with such natural characteristics as gradient, turbulence, depth and the presence of aquatic vegetation, but the speed with which it recovers from a polluting discharge is conditioned by the volume and strength of that discharge in relation to the amount of clean-dilution water available to receive it. It is in dry, low-flow periods that growers of artificially-irrigated crops most need to abstract, but it is in just those conditions that many streams can least afford to give up the water they need to maintain wholesome conditions. Where this situation

commonly recurs, not only must quality standards for effluents be stringent but unless and until the natural stream flow can be augmented, the volume of abstraction must be strictly controlled.

Projects under consideration

River authorities have considerable scope in carrying out their functions to conserve, augment and secure the proper use of water supplies. Different measures will be adopted to meet local needs, but projects under consideration include regulating reservoirs to store some of the high winter flood flows and release them in dry summer periods, estuarial barrages, recharging of aquifers from surface waters and, conversely, augmenting stream flows by pumping from underground sources. Such projects, whilst essentially engineering matters concerned with the provision and maintenance of water quantity, cannot be conceived apart from quality. The quality of a stream will influence the capacity of any regulating reservoir provided for it, and indeed the establishment of the machinery to develop means of conservation and distribution adequate for the country's needs places an entirely new emphasis upon the protection of water against pollution. Appropriate expansion of the pollution prevention service is taking place, and dischargers must expect increased activity by river authorities in the operation of the Rivers (Prevention of Pollution) Acts 1951–61.

Moreover, a good deal of research and development has taken place in the field of automatic analysis. It is now possible to measure certain quality aspects in this way and to record the results continuously. River authorities are planning, and in a few places have commenced to install such equipment at strategic points in their river systems, and although there is a long way to go before a full sanitary analysis can be carried out by such means, other instruments will be added as they become fully developed and available. The advent of automation to the river bank, giving constant 24-hour monitoring of water quality, may well put a period to the activities of those legendary few who are reputed to open all the valves on dark nights when the river is in spate, on the principle that what is not seen does not matter.

The need

In estuarial waters where dilution is unlimited and the needs of other abstractors are not threatened, it may be possible to allow a degree of liberty to the discharge of large volumes of strong waste which would be quite unacceptable to inland streams. As the vast majority of farms are located inland there will, for all but a few, be no alternative but to deal with their waste waters in such a way as will ensure that pollution does not arise. The need for such steps has not become of less consequence since that date in 1963 by which applications under the 1961 Act were required to be submitted for all pre-1951 discharges. On the contrary, the foreseeable demand/supply situation in this populous and highly-developed island gives the force of inevitability to the requirement that all those who need clean water must accept their share of responsibility for keeping it clean.

Subsequent writers will be discussing a variety of ways of solving the problem on the farm. There is space here for a few reasons only why those who get their living from the land should, in their own interests and for the public good, co-operate with river authorities in protecting this indispensable natural resource.

The need for a wholesome water supply on the farm is as imperative, if not more so, than in many other water-using industries. Farm animals require a supply which is not only chemically safe and palatable, but also free from pathogenic organisms and parasites derived from domestic sewage. The market gardener makes similar demands when spray irrigating salad crops which will be eaten uncooked. Both grower and grazier are therefore vitally concerned that town sewage and manufacturing wastes, which discharge upstream of the point at which they abstract or their cattle drink, shall be purified to an acceptable quality before discharge.

Hidden danger

Claims for damage to livestock as a result of drinking from waters polluted by toxic material have been successfully made and animal husbandmen are usually alive to this risk. What is less obvious is the possible cumulative damage to arable or horticultural land from the long-term effects of spray irrigation by water containing small amounts of such things as copper, zinc and nickel. Fortunately, the tolerance of fish to toxic metals in solution is very limited and river authorities' standards for them are already stringent in consequence. It is, however, clearly desirable that the concentration of these things in river water, if abstracted for irrigation, should not be so high that at normal rates of application the concentration in the soil is likely to rise, even in the very long term, to a level which would do permanent damage. I believe this to be a field in which there is scope for further inquiry.

The obligation

The farming industry is aware of its need of protection from the effects of discharges from local authority sewage works and industrial processes, and it must accept an equal responsibility for giving protection to the river against damage arising from the emission of waste waters from piggeries, milking parlours, dairies, silage clamps or stockyards, the careless use of crop sprays, and mishaps or lack of proper security in handling and using sheep dip. The industry as a whole has accepted this responsibility. At many farms and holdings a satisfactory remedy has now been applied. But there are differences, from one premises to the next, in the nature and size of the problem, the resources of the farm, and the preferences and opinions of the occupant. These, for the most part, yield to examination and discussion, and for the five years since the 1961 Act was passed, river authorities have pursued a farm drainage policy of gradual improvement by sympathetic co-operation and persuasion.

It is not, however, unreasonable to point out, (1) that the submission of a valid application in 1963, whilst affording a measure of protection, is not a licence to pollute; (2), that after five years in which methods and means have been developed and knowledge disseminated (river authorities having been greatly helped in these things by the Ministry of Agriculture, the N.F.U., the C.L.A., and others) anyone with farm waste to dispose of has now had ample opportunity to consider his problem and come to a decision upon the way he intends to solve it; and (3), in view of the rapidity with which the demand for large volumes of surface water of good quality is increasing, river authorities, whilst not abandoning their policy of gradualness and exercising patience where the circumstances are difficult, must now move

forward with a full programme to dispose of all 1961 Act applications and bring the many thousands of outstanding pre-1951 discharges under control.

Doubting the necessity

This article will not trespass into the field of ways and means, but it might be profitable to examine a few comments, not infrequently uttered since 1961, which seem to express some of the difficulties in the minds of those who may still doubt the necessity for the application of the Acts of 1951–1961 to the farm, or who may not fully appreciate all that is required. Here are two:

1. 'What harm does my little bit of muck do? It has gone down that ditch for the last fifty years and nobody is any the worse off because of it'.
2. 'Of course, there is a little colour in my drainage water where it goes into the brook, but by the time it leaves my land you cannot see any sign of it'.

The first speaker is perhaps limited by his horizon; any local nuisance in the small stream which traverses his land affects nobody but himself. More important, however, is that his little bit of muck is not alone. Together with the many more in the catchment area, it amounts to very much.

THE AUTHOR

H. C. E. Gatehouse, F.R.S.H., is Chief Pollution Prevention Officer for the Severn River Authority. He has had 30 years' experience in the environmental hygiene field of public authority service and has specialized in river pollution prevention since the setting up of river boards in 1950. He is a member of the Public Health Inspectors Association and an Associate of the Institute of Water Pollution Control.

A few years ago an estimate was made of the total volume of sewage and trade waste, excluding cooling water, discharging to the stream network of the River Severn. This was assessed at more than 100 million gallons per day in varying states of purification. Subsequently a rough approximation of the potential polluting load to be derived from the cattle and pig population of the area was assessed by assuming a similar density over the whole of the 4,410 square miles of the Severn catchment as was known to be the average for the counties of Hereford, Warwick and Worcestershire.

The figure arrived at was 790,000 cattle and calves and 340,000 pigs. Many animals would be at pasture and not contributing to the foul drainage flow from the farm. Moreover, strength and volume of drainage will vary with farming method. It was, therefore, decided to calculate for cattle and calves on only 50 per cent of that number, using accepted values of 10 gallons per head per day at a biochemical oxygen demand (B.O.D.) of 1,000 parts per million. This produced a pollution load equivalent to that from a human population of 330,000. Assessing pigs at 2 gallons per head per day, with a conservative B.O.D. figure of 7,000 p.p.m. (allowing for animals not contributing), gives a further equivalent pollution load of 400,000 persons.

So cattle and pigs together could, if pollution remained uncontrolled, contribute the equivalent in terms of pollution of 22 million gallons per day of domestic sewage. This is approximately 20 per cent of the total volume of man-made pollution to this river system from all other sources. Admittedly these figures give a rough, conservative estimate only, but even if the precise factual situation would produce only one-half of this amount, the introduction of the equivalent of eleven million gallons of domestic sewage into a river system which in its lower reaches (Worcester/Gloucester) can have a low flow in dry weather of around 250 million gallons, would still be very significant indeed. The answer to the first question then is that in total the many small discharges of farm drainage in any river system such as the Severn add up to a very considerable problem.

Self-purification—a slow process

The reply to the second question, which would judge the effects of a discharge by the visual evidence, is not unlinked with the first. The impact of any organic waste upon a watercourse does not cease when the visual evidence is no longer discernible to the human eye. The demands made upon the dissolved oxygen in the stream for the life, growth and proliferation of the microscopic organisms which attack and break down the complex substances, and for the oxidation of simple substances released into solution, continue over many days. Indeed the B.O.D. test, which seeks to simulate this process under controlled laboratory conditions, is conducted for a period of five days. The B.O.D. of silage liquor can exceed 60,000 parts per million, that of whole milk is around 100,000 p.p.m., piggery drainage may reach 14,000 and cowshed drainage 1,000. By comparison, average strength crude domestic sewage will be about 350 p.p.m.

The recommendations of the World Health Organisation for the quality of raw water abstracted for public supply stipulate an upper B.O.D. limit of only 6 p.p.m. The River Severn is still a major source of good quality water for public supply, but occasionally this figure of 6 p.p.m. is exceeded in the river at the points of abstraction. Such deterioration in one quality requirement is likely to be associated with others and the task of treating the water to a potable standard becomes more difficult.

It must be one aim of river management to ensure that water at all points of abstraction is of satisfactory quality. Clearly the small residual amount of pollution derived from any one farm discharge could not be separately demonstrated after it has travelled many miles via ditches and brooklets and tributary streams to form part of the large main river flow, but it is certainly present. The drainage problem at a great number of farm

premises would have to be solved before a measurable improvement could perhaps be demonstrated analytically in the lower main river reaches, but where one part per million or less may be significant, then no discharge contributing pollution to this situation can be disregarded. In the highly complex story of a large river system the ultimate main river quality is not the sole criterion. Local conditions in the smaller receiving stream will often dictate decision, but the foregoing does illustrate that to rest content, as the second question would require, with the removal of the visual evidence of pollution alone is quite inadequate.

Emphasis, if emphasis is needed on this point, may be found in the expanding water abstraction figures. At the moment some 70 million gallons per day of the River Severn water is removed for public supply. Projects already under construction or in the active planning stage will increase this figure to 160 million within the next few years. It is plain that the water must be used and re-used several times on its way to the sea and pollution prevention is seen to be not just another burden devised in Whitehall and added to by river authorities for the discomfiture of industrialists, farmers and local authority officers, but an inescapable necessity.

Seeking advice

Finally, readers of *Agriculture* are reminded that the staff of river authorities are freely available to discuss their problems. Instances have arisen in which farmers undertaking drainage alterations have sought competent advice elsewhere and have met every requirement of the local drainage authority, but have still left something to be desired in the interests of the river. It is earnestly hoped that those who have yet to solve their waste disposal difficulties will submit their proposals to the appropriate river authority for their area before undertaking commencement of structural works.

This is an introductory article to a series on the disposal of farm effluent. Future articles are planned to cover the following subjects:

Public Health	Animal Health
Agricultural Value	Dairy Husbandry
Buildings	Pigs
Machinery	Poultry

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49. The Vale of Pewsey

G. A. Dowse

THE Vale lies snugly protected and cossetted by the gentle curves of 800 ft-high downs on either side. William Cobbett approached it in 1826 from Everleigh and wrote '. . . a most beautiful sight it was'. To come suddenly upon it, as he did, from the downland, is the best approach.

At the west end, nigh on Devizes, where chalk meets the 'cheese' of the lowland regions and out of the district, the Vale is six miles wide, narrowing to three at the eastern Wexcombe end. Relatively flat, lying at 300 ft, and well-blessed with trees, it is a fair, rich land. Farms are reasonably large and in bygone days were all owned by King Alfred. Corn for 3–4 years, mainly the inevitable barley, with some kale and then ley gives a balanced cropping. Friesian cows predominate with some followers and occasional beef, but there is hardly a sheep to be seen nowadays and pigs or poultry are equally rare.

The Vale was formed by the erosive action of rain, frost and flowing water upon an upfold of chalk, which lays on a bed of sandstone overlying gault clay. The greensand was bared, and in places the gault, leaving the chalk on either side and as isolated hillocks in the Vale itself. The soil is fertile, though sometimes short of lime or potash and occasionally deficient in copper or manganese. Over-consolidation in wet weather must be avoided like the plague or the soil sets hard. Drainage problems are few and the River Avon, of double source, ably drains its length out through a breached gap in Salisbury Plain at Upavon; it then becomes the Salisbury Avon at Old Sarum.

Northwards, the district extends slightly to the north of the A4, encompassing the archaeologically exceptionally rich area of the Marlborough Downs (where Stonehenge's smaller stones, the Sarsens, came from), the fascinating Avebury Rings and the huge, man-made Silbury Hill. Countless Bronze Age round and New Stone Age long barrows abound, with their skeletons or urns containing cremated bones. All these are scheduled as Ancient Monuments and are a bane to the downland arable farmer. Farms are large in acreage, and are mainly under continuous barley with large dairy herds and even some Hereford beef. Some root-folded sheep, chiefly half-breds, are reminders of former glories.

Eastwards then, past racehorse stables, through Marlborough and its College, to Savernake Forest with its magnificent beeches and herds of wiid deer, and from there to the Berkshire border. The soil structure is clay-with-flints and chalkland, apart from the valley of the River Kennett itself. Many farms here have the Crown as landlord.

This is an area especially rich in insect life; in fact, three-quarters of those on the British List can be found in Wiltshire. It is rich, too, in the number of old farmhands still kept on rather than being pensioned off, and they tell, in their rich dialect, tales of the days before 1890 when the Great Buzzard was common. Green droveways abound, including the Ridgeway, part of that great track system of pre-Roman vintage running from East Anglia to the Axe and still valuable to farming; not so the Wansdyke, the deep, wide ditch barrier of post-Roman times erected to save the South-West from Saxon barbarism.

To complete the district area, southwards of the Vale, down to Larkhill, lies rolling chalkland and the wide horizons of Salisbury Plain. Here the War Department is the main landlord and new farm buildings for either corn or dairying have been liberally erected on land not subject to training. This is an area of continuous barley, large dairy herds and, despite difficulties, a high standard of farming, but with many single- or double-suckled beef herds, or fattening beasts and occasional sheep flocks. Wild oats are a menace and war must be waged relentlessly against take-all, eyespot, cereal root eelworm and arable grass weeds to ensure profitable crops.

Problems of land use arise, due to Army training. On the so-called Schedule III land, the tanks have right of way over the crops without need to compensate; but then the rent is very low. Wiltshire downland soil is not too thin and rarely shows white on ploughing. There are, however, several areas of black, puffy soil needing skill in consolidation and annual sprayings of copper to ensure good yields. Sparse of trees, the large, often unfenced and unwatered fields are well suited to herbage seed production. Rough downland abounds—a veritable botanist's paradise and a real ragwort menace—and additional potash is essential for ploughing it out.

Neolithic man, *circa* 2,500 B.C., settled in these open scarplands as the first British farmers—cattle-keepers rather than tillers of the soil, although the terraces of the strip-lynchets still remain as evidence of their primitive cultivations with flint hoes. Here, possibly, the first animals came to be made dependent on man, their former hunter, and the first seeds were saved and sown and the growing plant tended so that grain could be harvested. From this grew today's huge combine harvesters and large, complicated grain-drying plants and profitable-gallonage cows milked through Hosier bails on good leys.

It is, however, Pewsey Vale itself that captures the spirit of valley and down. A charming flora, with man adding daffodil and other bulb-growing for extra colour; white-washed or red-brick dwellings with thatch surmounted by 'dollies', beautifully executed by incomparable craftsmen; thatched cob walls (too many now crumbling away, alas, and too costly to renew); and a wealth of exquisitely beautiful churches built from the proceeds of wool profits, all account for Cobbett's description.

The winding Kennett and Avon Canal links the Kennett at Newbury to the Bristol Avon at Bath. Now disused, still water-filled but weed infested, the canal adds tranquil beauty to the scene. White horses cut in the chalk, seven in all in the district, are constant reminders of prehistoric religious rites appealing to the gods of fertility for plentiful crops and increases amongst the flocks and herds. Certainly the modern farmer has reaped the benefit of these appeals, even if his forebears did not.

The Vale of Pewsey can today well merit Cobbett's final comment: 'I never before saw anything to please me like this valley of the Avon'.

Dairy Cows are Individuals

R. R. Menneer
Agricultural Land Service, Cardiff

Cows are not so complicated as people, but they sometimes do things simply because they feel like it and not because they are made to do them. One of the essential features of a loose-housing system is that, within certain limits, the cows can behave as they wish. Space inside buildings is expensive, and some cow herds seem to manage with much less accommodation than others. This gave the A.L.S. reason to think that there might well be a relationship between a cow's behaviour and the range of space standards and systems of housing in use on farms. In early 1964, a pilot survey was therefore carried out leading to a detailed investigation on ten farms in England and Wales to study the reasons for some of these differences. The results and conclusions of the investigation will shortly be available, free of charge, in the A.L.S. Technical Report series.

So far as the general pattern of behaviour is concerned, the Friesian dairy herd appears to follow a 'natural' time-table; loose-housed cows in many countries within the temperate zone spend about 40 per cent of their time lying down and 20 per cent feeding.

Concurrently with this investigation, two members of the A.L.S. in Wales compared the activities of individual cows with those of the whole herd. On one farm the behaviour of four cows (the oldest and youngest cows and the highest and lowest yielders) was observed for one complete 24-hour period. The results tally with those from a second farm. Here the study was limited to the 8-hour period between morning and afternoon milking and extended to five days to discover the difference in behaviour from one day to another. The cows varied in age but all had calved within the last four months. The youngest (Melody) was a first calver but an old cow (Plum) had calved twelve times. The herd of 54 cows averaged about 900 gallons, individual yields ranging from $1\frac{1}{2}$ gallons (Queenie) to $5\frac{1}{2}$ gallons (Queenie IV). The cows were housed in a lean-to strawed area adjoining a self-feed silo.

The herd behaviour followed the typical pattern observed in the national study. The group of individual cows at each of the two farms behaved very similarly to the herd as a whole. But the actions of each cow varied from the herd or group patterns, and from day to day.

At the second farm, the herd as a whole averaged 20 per cent of the time feeding and 40 per cent lying down during the eight hours of daytime between milking. For the remaining 40 per cent of the time they were either loafing or idling. The following table illustrates the different behaviour of some of the cows observed.

Percentage range of variation in behaviour between morning and afternoon milking on five different days

Name of cow	Percentage of daytime spent		
	Feeding	Lying down	Loafing or idling
Plum	0–19	19–67	33–67
Melody	16–27	20–55	25–53
Beryl	14–26	19–39	43–59
Tendy II	14–28	11–46	27–61
Nelson	4–27	33–62	15–58
Hopeful	15–36	19–51	22–51
Queenie	4–20	32–63	20–60
Queenie II	10–32	4–38	40–85
Queenie IV	0–22	30–62	24–65
Janet	17–28	8–39	43–74

It is all too easy to ascribe human-like idiosyncrasies as being the reason for the variations in behaviour. It is plain, however, that these cows, with plenty of time and room to form their own routines, behaved differently for no apparent reasons. This emphasizes that stockmanship is essentially a study of behaviour, and this should be the basis of loose-housing design.

Social dominance undoubtedly plays a part, but on the two farms concerned it had only a very limited effect on the animals' behaviour. This problem becomes increasingly severe with large herds because there are more cows to bully the 'junior' cows. Farm buildings could be designed at extra cost to minimize bullying but further investigation is needed to find the place of the individual cow in the larger herds of the future.

To sum up, the behaviour of a small representative group of cows will generally be very similar to that of most herds in loose-housing systems, but the cow herself likes to do much as she chooses. How much the cow's behaviour could be altered without introducing stress, and the extent to which profits would be affected by designing cheaper buildings which might restrict her independence, are matters for further investigation.

AGRICULTURAL CHEMICALS

APPROVAL SCHEME

The 1967 List of Approved Products for Farmers and Growers

is now available

Copies may be obtained, free, by farmers and growers from any Ministry Divisional Office.

Since the 1967 List went to press, the following products have been approved:

FUNGICIDES

BINAPACRYL
Wettable Powders
Morocide—Hoechst

DINOCAP
Liquid Formulations
PBI Liquid Karathane—Pan Britannica

FENTIN HYDROXIDE
Wettable Powders
Erithane—Baywood

FENTIN HYDROXIDE with MANEB
For control of potato blight.
Wettable Powders
Fennite—Fisons Pest Control

MEZINEB (dithiocarbamate compound)
For control of potato blight.
Wettable Powders
Antracol—Baywood

Additions to 'Chemicals for the Gardener'

ACTRILAWN—May and Baker
Based on ioxynil for general weed control on new lawns sown from seed during the period of early establishment.

SIMWEED 6—Fisons Horticulture
Based on simazine for use in beds of established roses.

TOPROSE MILDEW SPRAY—Pan Britannica
Based on dinocap for control of mildew on roses.

HERBICIDES

BENAZOLIN with MCPB and MCPA
A further mixture of benazolin other than those listed in the 1967 List has now been approved. This is a translocated weed-killer for post-emergence use in cereals, undersown cereals and direct-sown seed seedling leys. Controls many broad-leaved weeds susceptible to MCPB with MCPA but in addition chickweed and cleavers.
Sodium Salt Formulations
Ley-Cornox HN—Boots

LINURON with MONOLINURON
A translocated and soil acting week-killer for pre-emergence use in potatoes for control of many annual weeds over a period of time.
Wettable Powders
Potato Weedkiller (Boots)—Boots

MCPA
Potassium and Sodium Salt Formulations
Angenol MCPA—Angenol Ltd.,
62 Deptford Church Street, London S.E.8.

PICLORAM with DICHLORPROP
A translocated weed-killer for post-emergence use in cereals for control of many broad-leaved weeds especially black bindweed, redshank, knotgrass, spurrey, mayweeds, chickweed and cleavers.

N.B.—Owing to risk of damage from picloram residues, straw from treated crops should not be used as such or as compost or manure on crops grown under glass.

Potassium Salt Formulations
Tordon 350—Dow Chemical

Books

cross references to the text, together with the synopsis at the beginning of each chapter, are excellent features. Although the authors profess only a little knowledge of economics, political theory, sociology and psychology, their book will be of interest to experts in these fields as well as to all involved in the science and practice of animal breeding.

Professor Lerner is well known as an author and his collaboration with Dr. H. P. Donald in the latter's first book is welcomed by British scientists.

F.K.D.

Modern Developments in Animal Breeding. I. M. Lerner and H. P. Donald. Academic Press, 1966. 63*s*.

This book is, perhaps, not what might be expected from two internationally-known geneticists. It is not a text-book on animal breeding and contains a minimum amount of technical language. Readers should not be deterred by one of the earlier chapters which outlines genetic theory simply and clearly; some of the future problems are pointed out, e.g., to find signs which indicate that a particular selection method has reached a point of diminishing returns.

The authors have made a reasoned appraisal of the justification for livestock improvement, its benefit to society and its future course. They remind the reader that society does not owe breeders or geneticists a living; both serve society through their work. If all sides of the livestock breeding industry accepted that their roles are complementary, then future co-operation and rapid progress would be achieved at the lowest cost per unit of genetic gain. The decision as to who should pay for livestock improvement and how much is, in the authors' opinions, more a political than a biological one.

Traditional breeding methods are criticized only for the slow pace at which they can effect improvement and, equally, scientists are criticized for failing to take sufficient interest in, or responsibility for, the application of their results for the benefit of society. The description of the evolution of large scale breeding is particularly interesting. Most people will agree that local breeds in possession of a territory cannot rely on their adaptation to local conditions to protect them from invasion from abroad, as witness the importance of U.S.-bred chicken in the U.K.

The book is well-written and printed. The extensive bibliography at the end and

The Use of Isotopes in Soil Organic Matter Studies. Supplement to the Journal of Applied Radiation and Isotopes. Pergamon Press, 1966. £10.

The book consists of 46 papers on eight aspects of the study of soil organic matter and the use of isotopes. These were originally presented at a Technical Meeting organized by the FAO in Germany from 9th to 14th September, 1963.

The first section covers the role of organic matter in soil productivity and the papers describe the factors involved in its natural breakdown and in its replacement. A paper by E. W. Russell is mostly about tropical soils in which he stresses the need for increasing the organic matter both within the soils and superficially as mulches.

In section two, the influence of soil organic matter on plant nutrition and metabolism is discussed. The papers show that the complex constituents of soil organic matter can be taken up from the soil. D. Sauerbeck and F. Führ used CO_2 labelled with C^{14} and demonstrated that it was readily absorbed by the plants through the roots. It is, therefore, important to ensure that any C^{14} which has entered the plant from complex organic compounds has not done so as CO_2.

W. Flaig describes the decomposition of straw in a section of papers on the chemistry of humic substances. His paper indicates the importance of soil fungi in the decomposition of lignins and shows how the addition of nitrogen accelerates the decomposition.

Two sections deal with the decomposition of plant tissue in the soil. D. S. Jenkinson reviews the turnover of organic matter in soils, and presents a mathematical model with a discussion on its validity when

applied to long-term field experiments.

The papers in section six include results from experiments using labelled C^{14} in plant tissues and tracing its incorporation into humic substances. A. Zeller, *et al.*, used *Aspergillus niger* as a convenient means of incorporating plant tissues labelled with C^{14} into the soil.

In the section on studies of organic nitrogen in the soil, it is noted that the use of labelled N^{15} is more difficult and more costly than the use of radio-active C^{14}. S. L. Jansson does not recommend the use of N^{15} for following the uptake of nitrogenous fertilizers but describes the special cases where its use is indispensable.

The last section includes papers on experimental techniques for using isotopes in studies of the soil and soil organic matter.

The book is primarily for specialists in the study of soil organic matter as most of the papers are rather technical, and the price tends to limit its appeal. The volume is excellently produced, although the few photographs are not clear. It seems a pity that it has taken nearly three years to publish.

J.M.A.S.

The Soils and Land Use of the District North of Derby. E. M. BRIDGES, 1966. 25*s.* (with map).

This Memoir, and its accompanying map, has real import as far as the East Midlands is concerned. It represents the only published soil survey within the region and will prove a valuable reference in connection with advisory work on soils, and for land use planning and teaching purposes. The territory surveyed covers the Geological Survey Sheet No. 125, the largest section of which lies in Derbyshire, but it also includes a part of west Nottinghamshire. This area has Derby on its southern boundary, Nottingham to the south-east, the old lead-mining town of Wirksworth to the north-west and Newstead Abbey, once the home of Lord Byron, near the north-east corner. The information given in the report will be particularly useful in advisory work as it can be extended to the adjoining areas where similar soils exist.

A general account of the district precedes the chapter on soil mapping, genesis and classification. Thirty-six soil series have been identified, of which thirty-four are mapping units. Twenty-one of the soil series have also been satisfactorily correlated with soil series established in earlier surveys.

Chapters III and IV describe the soil mapping units for the upland and lowland areas respectively. The upland division embraces soils on the Carboniferous Limestone and Gritstone formations, whilst the lowland zone covers soils on the Coal Measures, Magnesium Limestone, Permian Marl, Bunter and Keuper formations. The soil profile descriptions are excellently illustrated by block diagrams relating the soil pattern and topography. Black-and-white photographs are also included. In the tables presenting the analytical data in Chapter V, the absence of information on the sand size fractions is regrettable.

Chapter VI, on land use, is disappointing, though it should create interest among the general readers. It is too generalized and inadequate for the professional user in comparison with the remainder of the publication. More presentable and detailed information about the productivity of soils, capable of application at the farm and field level, is vital to stimulate interest and satisfy needs. To accomplish this task the active collaboration of soil scientists in the N.A.A.S. and other organizations is imperative. The improvement in the quality and utility of this chapter would make the exercise well worth while.

The standard of printing and the reproduction of photographs, diagrams and the map are of a high quality.

The Memoir can be recommended as a valuable reference to all those engaged in advisory work among farmers and growers and to land planners, lecturers and students. Farmers and members of the general public should also find sections of interest and value.

Copies may be obtained from the Librarian, Rothamsted Experimental Station, Harpenden, Herts.

B.W.

Meat Science. R. A. LAWRIE. Pergamon Press, 1966. 35*s.*

The author of this very useful and informative book is a reader in food science at the University of Nottingham and was formerly head of the meat biology group at the Low Temperature Research Station

at Cambridge. He has covered the widest aspects of the subject and in addition to his own knowledge, he has collected a wealth of references, many of which have hitherto only been available as separate papers. These are clearly listed in the bibliography and the book is adequately indexed.

The text is divided into ten chapters, commencing with a brief history of the origin and development of our meat animals. The following topics are then discussed in logical sequence: factors influencing growth and development, including genetic, physiological and nutritional aspects, structure and growth of muscle, with very clear tables, diagrams and microphotographs; chemical and biochemical constitution of muscle; the conversion of muscle to meat, which follows the sequence from pre-slaughter handling of the live animal to the desirable changes in muscle which occur after slaughter.

Chapter 6 deals with spoilage of meat by infecting organisms and is in some respects disappointing as there are certain errors, e.g., in a section on parasites, the author describes Trichinella spiralis as being a tapeworm, which it is not. The important subject of 'bone taint' is dealt with very briefly, and two references are to work done in 1918 and 1929.

On page 171, under a 1938 reference, the use of wiping cloths on carcasses is prescribed. In fact, more recent work shows that the use of water sprays is preferable and almost all civilized countries have abolished the use of wiping cloths or are in the process of doing so. On the same page the author states that 'A much higher standard of sanitation is required in chillers and in transport vehicles than elsewhere during the processing of meat'. This is disappointing. One would have hoped to find Mr. Lawrie campaigning for the optimum hygiene standard throughout the whole process of meat production.

There are many who will disagree with the suggestion that antibiotics may be employed to preserve meat. This is, in fact, prohibited in this country by the Preservatives in Food Regulation 1962.

The further chapters deal with storage, preservation and eating quality, including factors which influence it.

With the exception of the few criticisms, this is an excellent book and will be of interest to all who are concerned with the scientific background to meat production. The paper and printing are good, but the paper cover is less than the book deserves.

J.A.G.

Sheep Farming Today. J. F. H. THOMAS. Faber and Faber, 1966. 30*s*.

Some farming journalists would have us believe that the sheep industry is so hopelessly inefficient that only drastic measures can make its future certain. Mr. Thomas, with a lifetime of experience of sheep behind him, belongs to another school and has given us, in his new book, a clear appraisal of sheep farming today. The merits and faults of the different breeds available and systems of husbandry practised are recorded and provide a basis for constructive discussion and policy making. The author has taken a gamble with the title of his book; one might well ask 'when does today become tomorrow?'—for farming systems can change practically overnight.

The book begins with a section on the historical importance of sheep in Britain's agriculture, then takes us to see the numerous breeds and crosses and the conditions under which they are kept. A discussion on routine flock management and ways and means of reducing sheep and lamb mortality precedes the chapters on increasing the lamb crop, wool and profit. The last few pages are devoted to new developments.

To those of us concerned with training young men for the industry the following definition of the qualities required in a good shepherd offers food for thought: 'patience, diligence and keenness of perception—he must think more of his sheep than himself'. Can these qualities be taught or are they the result of breeding and environment?

Mr. Thomas believes that forestry plantations could provide valuable shelter for hill sheep but where are the facts to support this argument—would not the money be better spent on extra feed or land improvement?

Large-sized breeds have always been associated with good land and low stocking rates, but current work is showing that the smaller-sized breeds (draft hill ewes) can adapt themselves to intensive conditions of high stocking rates and fertilizer application. Should output per acre or per capital investment rather than output per ewe be the criterion for evaluating sheep today?

One would have welcomed the inclusion of new information in the chapter on ewe and ram fertility while the section on wool fails to do full justice to this valuable product (or by-product?). Why are breeds of livestock usually illustrated by photographs of show sheep that bear little

resemblance to everyday commercial sheep? These are but minor criticisms of what is not only an instructive but also an enjoyable book by one held in high respect by the sheep industry.

G.L.W.

A Bibliography of Farm Buildings Research. Part V—Buildings for the Drying and Storage of Grain 2nd Supplement, 1962–64. Agricultural Research Council, 1966. 5*s*.

This useful supplement ranges over a number of important features relating to grain storage. The behaviour of grain in storage and the basic details of grain drying are covered. Other matters dealt with are principles of storage, construction of stores, grain handling, pest infestation and the economics of drying and storage.

Included is a report on trials in Rumania. It was there found that wheat was preserved equally well-stored either $7\frac{1}{2}$ ft deep or at depths from $11\frac{1}{2}$ ft to just under 15 ft. Under local conditions, with a moisture content below $13\frac{1}{2}$ per cent, turning each year was unnecessary. To contemplate storing wheat at these depths for years is truly remarkable.

Nearer home is an account of large bulks of malting barley in commercial storage. The conclusion reached was that in Britain cooling by in-store aeration was a reliable and economic method of avoiding trouble from insects. An additional advantage was that economies were made in the amount of drying or cooling in driers. Cooling in this case ranged between 17°C and 22°C. The moisture content is not disclosed and so comparison with other reported work is not completely possible.

Finally, from America comes a warning on structural failure of steel tank grain stores. There it was found that considerable temperature falls, resulting in the change of the steel to a brittle state, appeared to be the principal cause of failure. A second major contributory factor was the introduction of internal stresses in steel plates during fabrication and in some storage situations. The report concludes that improvements in design and fabrication could reduce these hazards.

Examples like these serve to show how unceasing research is working in the interests of agriculture and emphasizes the value of this bibliography.

C.R.

Basic Farm Machinery. Volumes 1 and 2. J. M. SHIPPEN and J. C. TURNER. Pergamon Press, 1966. Vol. 1. 17*s*. 6*d*. Vol. 2. 15*s*.

These two companion books have recently been published by the Commonwealth and International Library. They offer a very simple but easily readable basic introduction to the farm tractor and a useful range of field machinery.

The first volume is devoted to the tractor and its component parts. It describes the engine principles, transmission of power fuel lines and ignition system, together with a description of the hydraulic system. The text is simply written but clearly explains the principles involved. The whole work is profusely illustrated with two-colour line drawings giving a clear picture of the part or parts involved. This book is right up to date. It covers diesel engines as well as spark ignition units and describes the principle of operation of disc brakes. There are also chapters on basic mechanical principles, electricity, heat, materials and workshop tools. In most of these, beginners will find some useful practical hints and tips.

The second volume contains good descriptions of a range of field machines and also covers the adjustment and setting of these to prevent faulty operation. In addition, there are lists of maintenance routines for each machine. The haymaking section deals with mowers, tedders and turners and also has sections on crimpers and roller crushers.

Although the authors claim that these books are primarily written for beginners and school-leavers, the up-to-date contents will be of interest to older people who wish to gain some real knowledge of farm machines. It is certain that they will become standard text-books in all Farm Institutes where students are taking the City and Guilds Examinations in Farm Machinery. They will also be useful for members of Young Farmers Clubs who need some theoretical knowledge to help them pass the proficiency tests, and agricultural apprentices should also find them useful. For many years no simple text-books were available for such courses and often both lecturers and students were in difficulty when seeking knowledge on these subjects. The two volumes should go a long way to standardizing a level of instruction at all Farm Institutes and extra-mural classes, for these books will be a 'must' for all lecturers in farm machinery.

F.L.G.

Books Received

Documentation in Agriculture and Food, No. 84. Co-operative Research on input/output relationships in use of Fertilizers in crop production. Organisation for Economic Co-operation and Development, 1966. 10*s.* 6*d.*

Feeding for Beef Production. Collected papers presented at a conference held at Harrogate in March, 1966. Copies from the U.S. Feed Grains Council, Locomotive House, Buckingham Gate, London S.W.1.

Farm Planning Data, 1966. Compiled by J. B. Hardaker. Copies from Farm Economics Branch, School of Agriculture, Cambridge, 3*s.* (including postage).

Fat Cattle Auction Markets in Great Britain. W. G. R. Weeks and G. H. Brayshaw. University of Newcastle upon Tyne, Department of Agricultural Marketing, Report No. 3, May, 1966. 15*s.*

The Organisation of Fatstock Slaughtering. Katherine Dent and W. J. G. Cowie. University of Newcastle upon Tyne, Department of Agricultural Marketing, Report No. 4, 1966. 15*s.*

The Competitive Advantages of Alternative Methods of Meat Retailing. G. H. Brayshaw and R. J. Perkins. University of Newcastle upon Tyne, Department of Agricultural Marketing, Report No. 5, 1966. 15*s.*

Methods of Appraising New Capital Investment in Agriculture. H. W. T. Kerr. University of Nottingham, Department of Agricultural Economics, Sutton Bonington, Nr. Loughborough, 1966. 5*s.*

Locational Advantage in Tomato Production. R. R. W. Folley and R. A. Giles. Copies from Department of Agricultural Economics, Wye College, Ashford, Kent. 1966. 5*s.* (including postage).

Rural Industries Bureau Annual Report, 1965–66. 5*s.* 6*d.*

Smallholders in Cheshire. Their Economic Life and the Lessons to be Drawn. John Stewart. Bulletin No. 112, Department of Agricultural Economics, University of Manchester, 1966. 7*s.* 6*d.*

Entry into the European Common Market and British Agricultural Income. T. Kempinski. Bulletin No. 114, Department of Agricultural Economics, University of Manchester, 1966. 3*s.*

The Economist, Agriculture, and National Development. An inaugural lecture by John Ashton, Professor of Agricultural Economics, University of Newcastle upon Tyne, 1966. 5*s.*

A Comparison of Pig Production in England, Denmark and Holland. F. G. Sturrock and R. F. Ridgeon. Occasional Papers No. 11, Farm Economics Branch, School of Agriculture, Cambridge. 1966. 4*s.* (including postage).

The E.E.C. Regulations for Pigs and Pigmeat. Prepared for the Pig Industry Development Authority by R. C. Rickard. Department of Agricultural Economics, University of Exeter, 1966. 7*s.* 6*d.*

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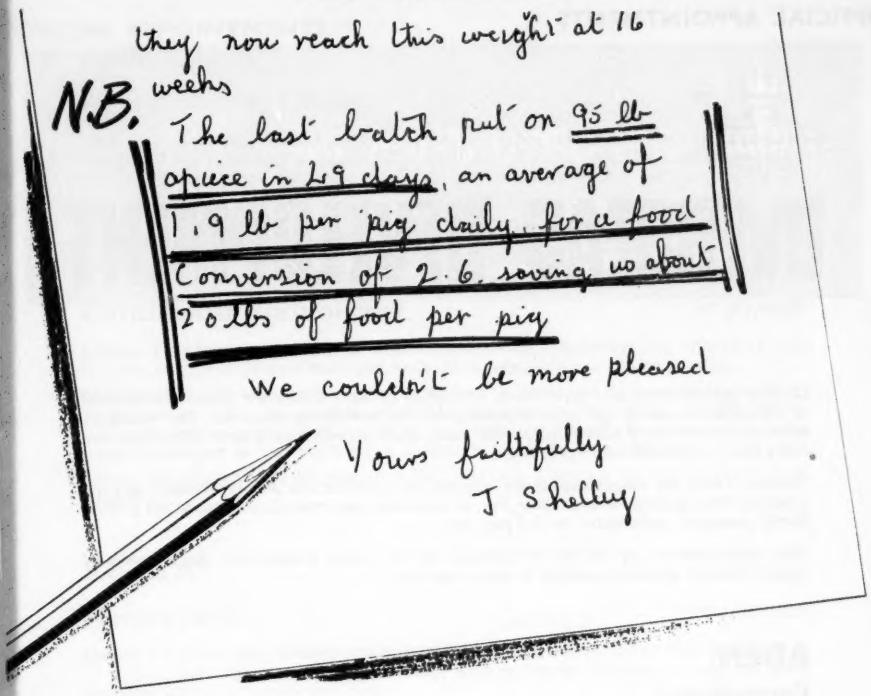
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RC 213/68/011

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OFFICIAL APPOINTMENTS

GAMBIA—*cont.*

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Duties: To organise and supervise the overall crop protection unit, including the control of stored products insect pests, and general supervision and liaison with the Produce Chemist, the introduction of field and orchard crops protection techniques and the improvement of protection in village seed stores.

Qualifications and terms: A degree in Natural Science or Agriculture with post graduate experience in the control of insect pests in stored products. Salary £1,140—£2,224 a year plus 25% terminal gratuity. Contract 12 to 24 months.

Citriculturist/Horticulturist

RC 213/68/09

Duties: To plan and execute the commercial production processing and marketing of limes on a pilot project basis and to develop subsistence vegetable growing.

Qualifications and terms: Candidates must have a degree or diploma in horticulture or agriculture with considerable practical experience of the duties outlined above, preferably in the tropics, and an ability to conduct rootstock, fertilizer and cultural trials. Experience in the maintenance of records would be an advantage.

Salary: £1,140 to £2,224 per year plus 25% Gratuity. Contract for two tours of 15–18 months.

KENYA

Horticulturist

RC 213/95/037

Duties: To investigate, develop and extend the industries dedicated to the improvement of tropical tree crops on the Kenya coast with particular reference to cashew nuts, mangoes, citrus, coconuts and bixa.

Qualifications and terms: A degree in Horticulture with two years' post graduate training preferably in experimentation of the crops. Salary £1,374 to £2,757 a year plus 25% terminal gratuity. Two years' contract.

Biometrician

RC 213/95/039

Duties: To advise and assist in the interpretation of statistical trials conducted by the Research Division of the Agricultural Department.

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Agricultural Officer (Extension)

RC 213/154/03

Duties: Required to supervise, train and guide existing extension personnel in technical agriculture programme planning and soil conservation methods; to advise farmers in crop and animal husbandry; to undertake certain administrative duties.

Qualifications and terms: A degree in Agriculture. Salary £1,424 to £2,170 a year plus 12½% terminal gratuity. 2–3 year contract.

cont'd overleaf

OFFICIAL APPOINTMENTS

UGANDA

Agronomists

RC 213/183/06

Duties: To carry out an experimental programme on either sugar, tea or tobacco with the object of improving production methods and quality.

Qualifications and terms: A degree in Agriculture with at least three years' experience of tropical agriculture, preferably specialising in one of the above-mentioned crops. Salary £1,374—£2,757 a year, plus 25% terminal gratuity. 21–27 months' contract.

Soil Conservation Engineer

RC 213/183/02

Duties: To carry out soil conservation measures on projects, to check layouts, to train field staff and to collect data and prepare a handbook.

Qualifications and terms: A degree in agricultural engineering or in soil conservation, or a degree in civil engineering and soil conservation. Experience in soil conservation is desirable.

Salary: £1,374—£2,757 a year plus 25% terminal gratuity. 21 to 27 months contract

Agricultural Chemist

RC 213/183/022

Duties: Research work on soil fertility problems connected with tropical rotations, manures and fertilizers.

Qualifications and terms: A degree in agricultural chemistry or chemistry, plus at least two years' post-graduate training or experience in soil science.

Salary: £1,374—£2,757 a year plus 25% terminal gratuity. 21–27 months contract.

SARAWAK

Agricultural Officer

RC 213/155/04

Duties: The administration of an Agricultural Division, comprehensive advisory and supervisory duties and supervision of experiment stations and staff training.

Qualifications and terms: A degree in Agriculture or Natural Science plus at least two years' experience of tropical Agriculture. Salary £1,680—£2,905 a year plus terminal gratuity. Three-year contract.

ZAMBIA

Entomologist

RC 213/132/03

Duties: To carry out research on the identification and control of pests of agricultural and horticultural importance.

Qualifications and terms: A degree in botany, zoology or entomology, preferably with post-graduate experience in applied entomology.

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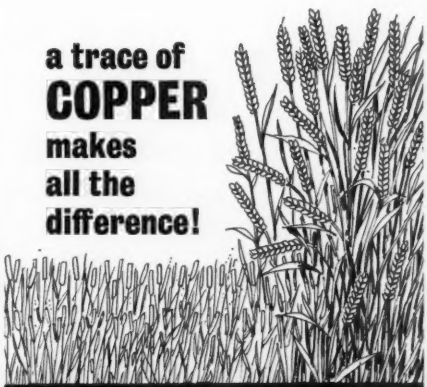

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